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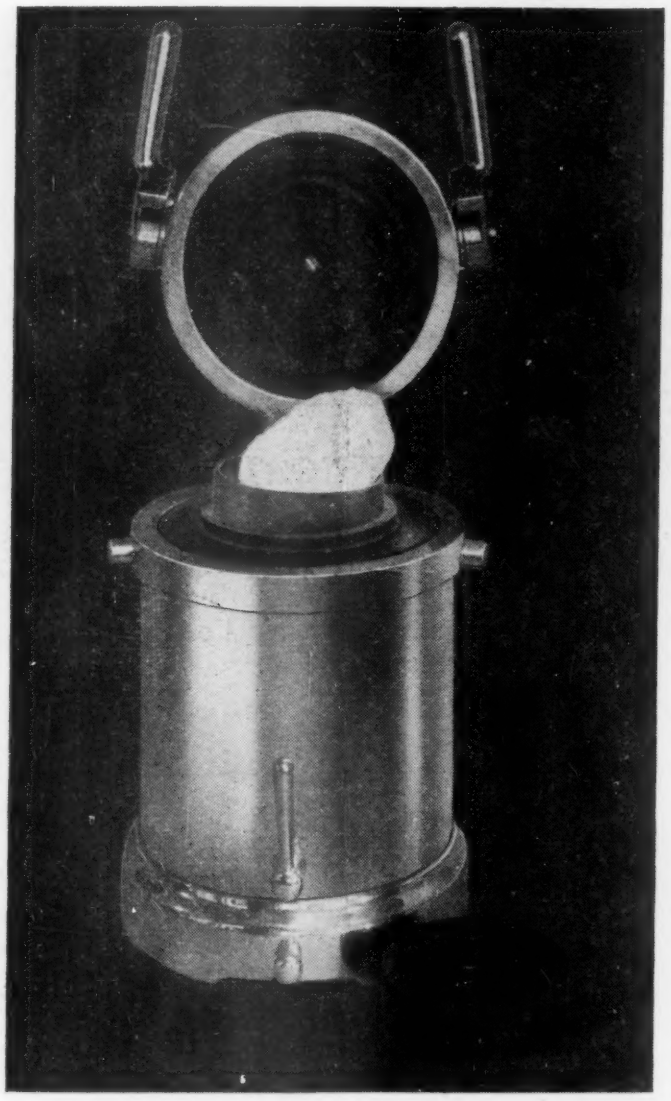

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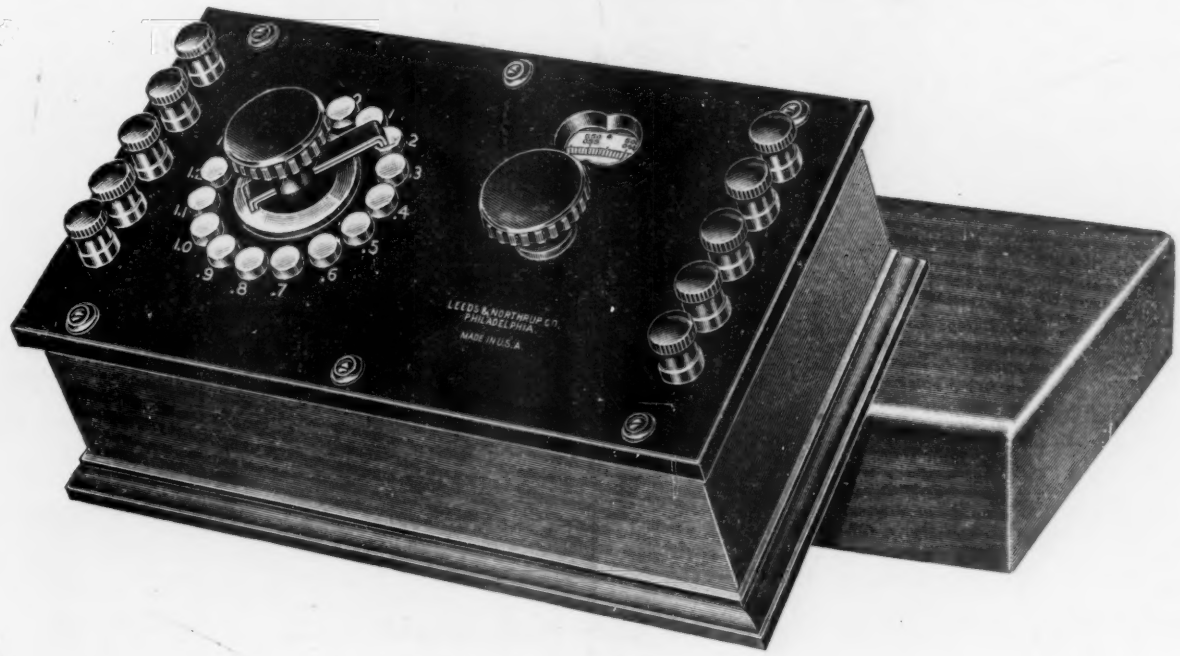

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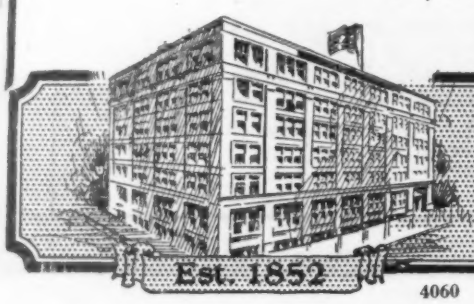

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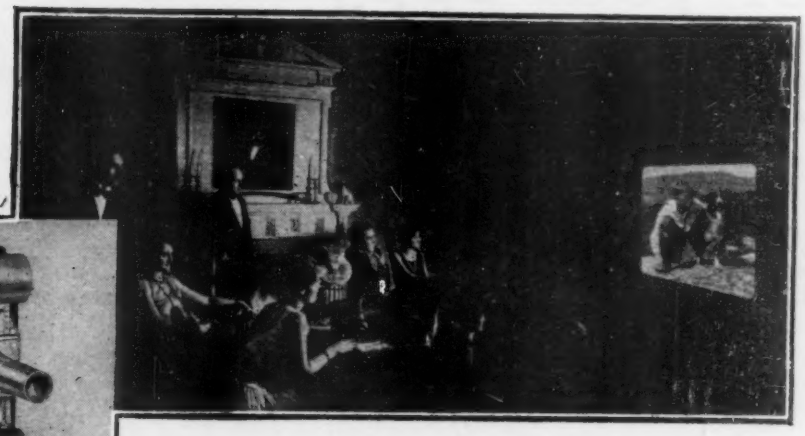

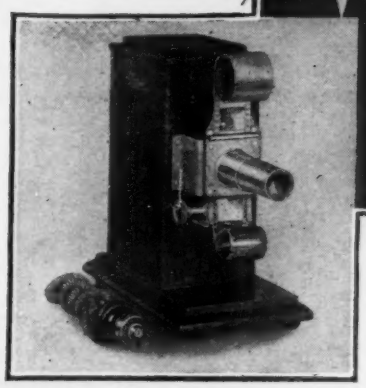

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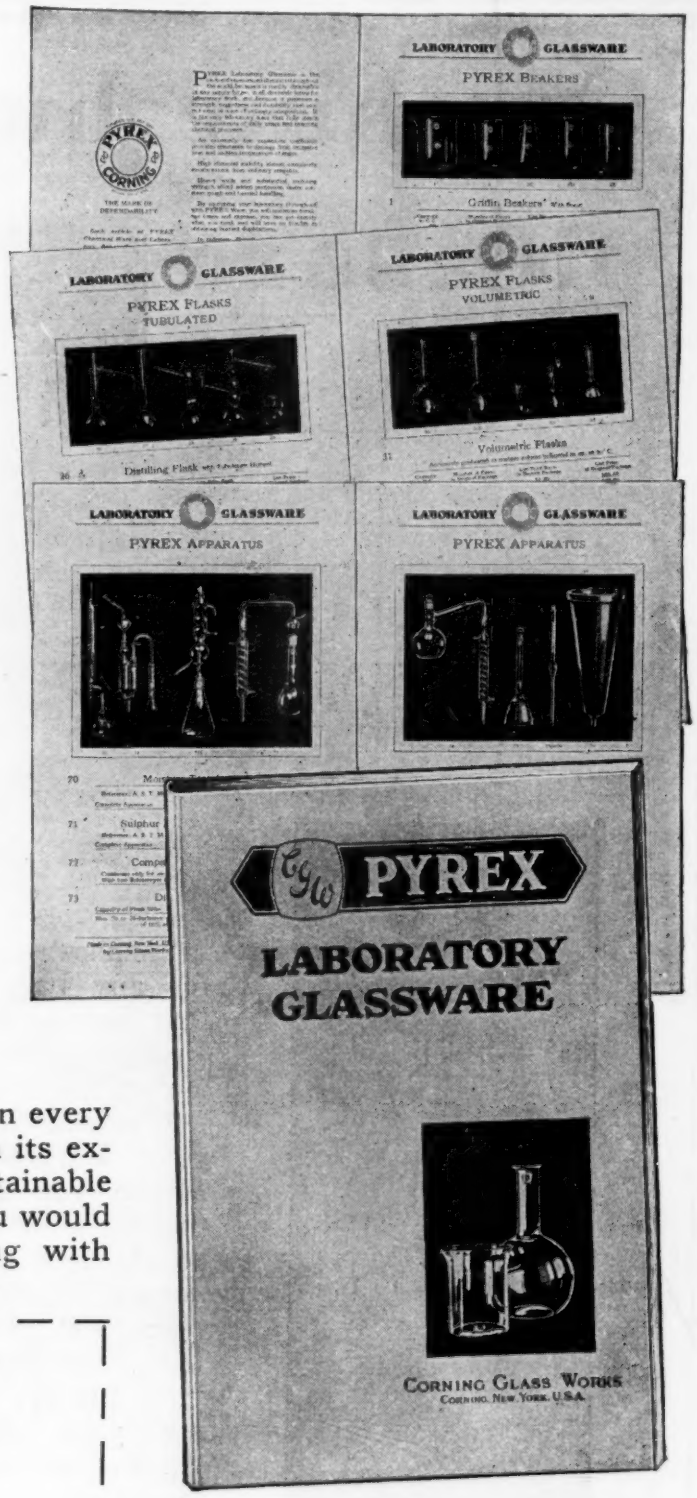

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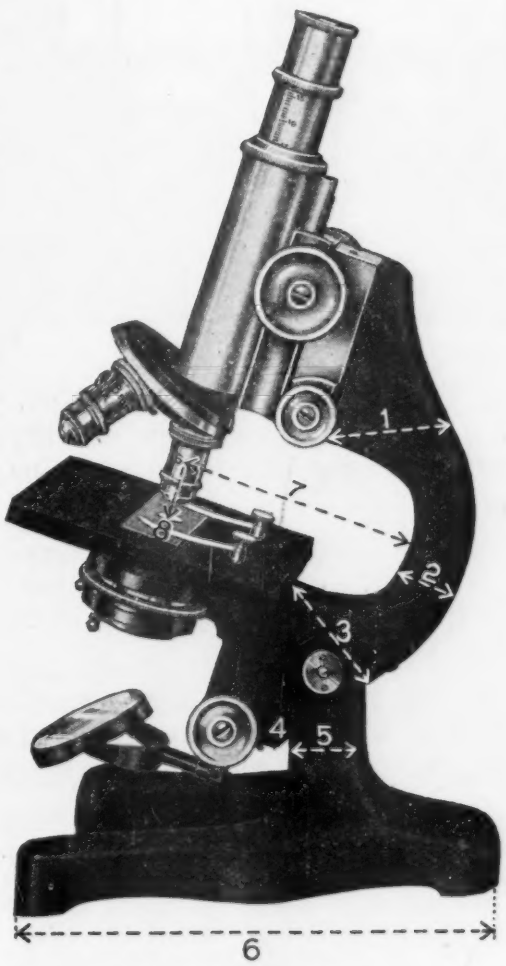

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VIEWS OF HIGHER SEED PLANT DESCENT SINCE 1879[1]

By Dr. G. R. WIELAND

YALE UNIVERSITY

IN the year 1876 the celebrated Thomas Henry Huxley visited at Yale my old preceptor, O. C. Marsh, finding intense interest in the new collections of vertebrate fossils from the Tertiary of the west. In the "Life and Letters of Huxley," edited by his son, Leonard, there are given full references to the sojourn in New Haven. In Huxley's opinion there was no European collection of mammalian fossils quite equal to that then assembled by Marsh. Its glory was in the fossil horses. For the first time, said Huxley, a series of fossil species leading into a living type had been brought to light.

Those were brilliant days in biology. The "Origin of Species" and the "Descent of Man" had appeared but a few years before. In the closing paragraphs of the "Descent" Darwin had paid fine tribute to the genius of Haeckel, who "had confirmed nearly all his own conclusions." But as yet the lore of fossil plants had not reached the distinctiveness first seen in the invertebrate and then in the vertebrate records. Much was indeed known about fossil plants, going back to those patriarchs of paleobotany, Brongniart, Goeppert and Williamson. In 1868, too, William Carruthers had brought out a splendid account of the fossil cycadean stems from the secondary rocks of Britain, including histologic study of the utterly isolated and singular seed cone of *Bennettites Gibsonianus* from the Isle of Wight, while two years after came Williamson's later notes on the "History of *Zamia gigas*." But the "scaly heads and collars" of the Yorkshire coast still remained "Williamson's riddle," while Carruthers, perhaps too much impressed by the utter singularity of the mature cycadeoid cone structure, is credited with the thought that

[1] Opening address at the eastern meeting of the Botanical Society of America at Dartmouth, June 25.

it was very unlikely that fossils would ever feature the events in plant descent much more closely than they already had.

How little could then be discerned of higher seed plant descent in older plant records is told in few words by Joseph Dalton Hooker in a letter to Arber, lately quoted by Hutchinson:

> With regard to your queries respecting the primitive type of angiospermous plants, that subject has never been far from my mind for upwards of half a century, during which period I have failed to grasp a feature in the morphology, physiology or geographical distribution of angiosperms that gave much color to whatever speculations I may have indulged in respecting it. I do not share Engler's views as expressed in his classification and writings. The classification is neither better nor worse in the abstract than DeCandolle's (so-called), and is far more troublesome to apply for practical purposes.

The passage is quoted in full as direct testimony to the fact that while the artificial plant systems have always held near to certain larger outlines that must have some relation one way or the other to true evolutionary series, any accord as to the starting-point is very recent. Darwin could well say in 1879 that the origin of the angiosperms was an "abominable mystery," and except for the fact that Ginkgo could be called "a living Cordaite," the origin of the gymnosperms was nearly as mysterious. Whether the fact was very consciously in the minds of botanists or not, some discovery of new types of fructification leading into gymnosperms, or from them toward angiosperms, could alone lead to bettered ideas of higher plant descent. What could be inferred from the isolated records of stem structure or foliage could only adumbrate, without defining, the general course of change in the successive canopies.

A first rift in the veil of mystery resting over not merely angiosperm but more or less all higher seed plant descent seemed to come as if by chance, though not from an entirely unsuspected group—the cycads. That flowers and cones must go back to carpels was long noted, but that some marvelously composite type might suddenly flash into full view, as did the flower of *Cycadeoidea ingens* in 1899, was not quite foreseen. From that year on, down to this evening, discovery illuminating the course of phylogenetic change in seed plants has so outrun even well-placed theory that he must be a modest botanist indeed who would admit that the plant record has contributed less to ideas of the greater evolutionary course than either the invertebrate or vertebrate records.

Continuing the recital, it is recalled that the very first of the short papers on cycadeoid fructification was sent to A. G. Nathorst. He had had in hand certain late Triassic plants from Skone which seemed of very debatable relationship. As it happened, too, Nathorst had collected Williamsonians at Cloughton Wyke in that dark year of 1879! Cone structure in his types being so generalized, however, and the fact that the Williamsonians belonged to a great tribe of flowering gymnosperms remaining as yet hidden, instead of a single, there now seemed to be two "riddles." There were made, it is true, various suggestions of angiosperm analogies, although always from indirect or insufficient view-points. But as soon as a related petrified form appeared in the foreground, the situation cleared. Study could now be successfully extended to the casts and imprints.

Nathorst could now see what to look for in his material. He later said, as he showed me his finely elaborated collections, "While it should have been possible to reach exactitude from the beginning, without your discovery of the petrified flowers I much doubt if I would ever have found the incentive to restudy of the Williamsonians, or have gained ideas of how to proceed."

We may, then, at this point briefly sum up the fossil discoveries bearing on higher seed plant evolution:

I. The flower of *Cycadeoidea* indicated that the "complete flower" with bracts, sepals, petals, stamens and a central seed cone was old and of varied form. It suggested great possibilities of variation in emplacement, and in fusion and number of parts, with long courses of both giantism and reduction. The stamens, as old as Marattia, were astonishing.

II. *Wielandiella* is either a "missing link" or a plain ordinary early member of the Magnoliales. It might well be such. Discovery of the staminate features and wood structure is awaited, but the habitus is so distinctly that of a Magnolia that Gothan says the type is "at least as significant in the plant as *Archaeopteryx* is in the animal world." In 1901 Coulter[2] and Chamberlain could say that the cycadeoid fructification mainly indicated transitions between pteridophytes and gymnosperms, without as much suggestion of angiosperms "as living gymnosperms had already given." That was then the fair statement to make, although but a single year later the restudy of *"Anomozamites"* thus brought into view a type which solely because of its reduced seed cones could be considered as related to cycadeoids at all—a type now to be regarded as more angiospermous than gymnospermous, if floral plan and vegetative habitus combined signify anything in descent.

III. *Seed ferns.*—In 1903, only a year after Nathorst's first restudy of the Skone fossils, Oliver and Scott announced the discovery of the seed-bearing quasifern, *Lyginopteris.* Since then many extensions

[2] John M. Coulter, "Relations of Paleobotany to Botany," *Amer. Nat.*, vol. XLVI, 1912.

of knowledge of the "seed ferns" have been made. But as in the cycadeoids and the *Wielandiella* series, some of the most important features are yet to determine. Pencil in hand, many hypothetical Pteridosperms may be sketched. Somewhere near or within this group it may be believed the simplest of anthostrobili were developed—plants bearing staminate fronds below, and ovulate above, or tending to do so, and then gradually organizing the two types of sporophylls on axes of limited growth; or in part becoming dioecious, and organizing cones of both sexes, after the manner of cycads. If there was an upward course from Selaginella it is still undiscernible.

IV. *Vegetative features of the older gymnosperms.*—There is no need here to single out the many studies of the past thirty or forty years which have brought into view the fact that the Devonian, Carboniferous and the Permian were periods of extremely varied stem structure in the older seed-bearing plants. Besides the varied types of Cordaites running well back into the Devonian with the remarkable cosmopolitan genus Callixylon, there may be merely mentioned the transitional Heterangium and the many so-called Medullosan types. And then there is to note the Rhetinangium, Kalymma of our own Kentucky Devonian, Bilignea, Stenomyelon, Protopitys, which Scott says bore its leaves in two alternating rows, one row on each side of the stem as in the "Traveler's Tree" of Madagascar, and the even more remarkable Cladoxylon series of stems. Finally, too, the restoration of the Upper mid-Devonian Eospermatopteris as studied at the State Hall at Albany by Winifred Goldring has a fine value, and can not fall short of a virtual reality. This type may be an early Medullosan.

V. The investigation of the Cretaceous coniferous lignites of Kreischerville, Long Island, in 1909 by Hollick and Jeffrey must be given a high place in paleobotanic records, not alone because of the accurate descriptions of significant stem types, but also because this was really the first successful study of such lignites. Nathorst had led the way, but here a further refinement of method was made. Ever since, the possibility of similar studies of lignites containing the older angiosperm stem structures has seemed near, seems only to await some fortunate observation of Triassic or older lignites.

VI. *American coal balls.*—By "coal balls" is usually meant petrified parts of lesser coal seams, mainly calcitic. Often, preservation is exquisite, and there is the great advantage of occurrence of varied types in the closest association—the disadvantage of an exceeding difficulty of study because of this very fact. The well-oriented thin section with respect to the given stems, foliage or fruits in the mass of plants is not entirely fortuitous, though nearly so in the case of lesser seeds or leaves. After determination of the position of stems or cones of fair size, with care, the oriented section may often be cut. But final study and elaboration thus require a familiarity with both occurrence in the field and slow accumulation of reference types.

The year 1855 was momentous in the history of paleobotany for the description of the Trigonocarpon seeds from "certain limestone nodules enclosed in seams of bituminous coal" by Joseph Dalton Hooker and Edward William Binney. But quite thirty years passed before the investigation of the English "coal balls" could be said to be well under way.

By some lapsus, fatality, inadvertence or inattention on the part of geologists or botanists, it was not until 1923 that Professor Noé, sixty-eight years after the Trigonocarpon sectioning by Hooker and Binney, secured the first American coal balls and successfully began their observation, collection and study at the University of Chicago. Since then, many determinations have been made. How far paleobotanists may extend discovery of critical structures preserved in the coal balls is still somewhat uncertain. The coal-ball record, being so much that of shore levels and lines, may prove in the longer course of study to be too one-sided, with but scant evidence of more plastic inland, plateau and mountain vegetation. Nevertheless, it is certain that the coal-ball plants are a great and alluring field in which many significant discoveries must yet be made. It may be that the Mississippian and Pennsylvanian coal balls come too early in time to yield indisputable progenitors of the angiosperms, but I am one of those who believe that a real step forward was made when it was suggested that it will not do to call old stems pteridospermous too generally, and that from somewhere within the Medullosan assemblage the monocots were possibly derived. Strange, if the Medullosans all went down to an utter extinction too soon for any of them to have made initial change toward strobilar or floral organization.

VII. *Conifer antiquity.*—The necessity for going through the collections of fossil plants for the purpose of restudying the little known or problematic conifers by improved methods has been recognized for some time, and has now had for several years the attention of Dr. Florin, of the Natural History Museum at Stockholm, where repose the splendid Nathorst collections. Both Abietineans and Araucarians go back to the Carboniferous, with the former more abundant and varied than perhaps expected. Furthermore, John Walton has recently confirmed such results by the description of a Voltzia obtained

from a boring in the Carboniferous. As the result of careful development it appears that the Voltzia lax cone unit consists in a median and several lateral sporophylls subtended by a large protecting bract. Once more the best explanation is that of a short axillary shoot of a kind easily undergoing simplification.

A negative result bearing on the age of the conifers merits citation here. In my collections from the Como of both the Black and the Freeze Out Hills are certain conifer stems associated with the Dinosaurs and the Cycads, sometimes of singularly fine preservation. One of these stems from the northeastern Black Hills was some time ago turned over to Dr. H. J. Lutz, of the Yale Forestry School, for sectioning and study. It is of course specifically new, and conveniently set in the rather comprehensive fossil genus Cupressinoxylon. But the wood structure as preserved in all detail, if found in a living form, would be referred to either the genus Cupressus, or else to Juniperus. These genera, therefore, unless undergoing some recent specific development, have so far as wood structure goes undergone almost negligible change since the close of Jurassic time. Dr. Lutz's study will shortly be published. Several related species have been sectioned, awaiting close study.

My own studies of the Patagonia cones from the Cerro Cuadrado also show the present-day coniferous types to go far back, but have the further interest of bringing to light cone types intermediate between Abietineans and Araucarians.

VIII. *Caytonia.*—The discovery of the singular angiospermous fruit called Caytonia by Hamshaw-Thomas brings to view an unexpected Jurassic type by very careful methods of study. The significance of Caytonia lies partly in the lively expectation of further such discoveries, partly in the suggestion of somewhat of primitiveness in the carpellary type. Were it certain that the accompanying foliage really was of the Sagenopteris type, the fact would be important in gaining further ideas of Jurassic leaf change and the several modes of origin of the net venation.

Having enumerated in more or less casual manner some of the outstanding discoveries or courses of discovery which have signally influenced views of seed plant descent in more recent years, it is easier to note present-day views. Apropos of the monocots it is seen that the view of a dicot derivation is generally accepted. It is pointed out that the Ranunculaceae are the most primitive herbaceous dicotyledons. No one can dispute that view now. A tree peony (*Paeonia moutan*) is a very instructive plant. Bessey in his synopsis of plant phyla, moreover, placed the Alismales at the base of the monocots—that being the very group that can be cited as next related to the Ranunculaceae. When, then, did separation occur? When it was suggested a few years ago that the monocots may have split off from other anthophyta as far back as Carboniferous time it was rather hotly urged by some that that could not be, because all medullosans must be seed ferns. That could not be!

Why not? Seeds with two cotyledons, in view of their splendid and varied development in the Cycadeoids, with presence in Araucarians, must be very old. Vessels may be very old too. If they could arise in a simply explained manner in the dicot lines, they could also appear in monocot lines. A direct derivation of monocot stem types from the Lyginodendron-Heterangium complex is not an iron-bound impossibility. With stem and leaf plasticity granted for the medullosans, in them as well as in other pteridosperms, primitive types of flowers, proanthostrobili, could arise.

A few old, even prejudiced, views should here be set aside, or at least proved out. Monocot origin can no longer be viewed as simply as when dicot stem, foliage and floral features were believed post-Jurassic. The single Jurassic angiosperm stem described by Kraeusel proves once more how slender fossil evidence may long remain. Palms, too, are old looking in the sense that they have changed long and much. They are, when it comes to fruiting, facile branchers. Denial that Medullosans could run into floral types or be closely related to the primitive stocks of flowering plants is the same as saying that was impossible to seed ferns in general. The larger outlines of stem morphology and stem history make monocot descent from within or near the medullosans a very distinct possibility.

A few years ago the hiatus between pteridosperms and early magnolias seemed impassable. There was no visible tie-up in stem structure or fructification. That the great tracheids of Lyginopteris might account for the origin of vessels is still omitted from consideration. Vessels and net venation are thought to have come rather late in angiosperm history. None the less, later consideration of Wielandiella greatly affects all the view-points. The general fact that origins are being pushed back so far greatly favors diphyletic views.

The idea of monophyletic origin of the angiosperms has been more carefully considered by Ethel Sargant[3] than by any one else. Without reviewing in detail the argument she presents, it is here urged only that after all it is determination of the appearance of

[3]Ethel Sargant, "Reconstruction of a Race of Primitive Angiosperms," *Ann. Bot.*, vol. XXII, 1908.

organs in geologic time which it is sought to determine. Like megaphylly and microphylly, the terms mono-, di- and polyphyly too readily become vague in the course of discussion.

The question of the monophyly or polyphyly of the monocots and of the dicots finds analogy in that of the conifers. There it is the singularly clear Stephanie Herzfeld,[4] who has given an excellent résumé of the view for the unity of the greater conifer phylum. Eames had reached similar exact views. Jeffrey has contended that Araucarians are descended from Abietineans. And I have for the present convinced myself from the study of those marvelous Cerro Cuadrado cones of Patagonia that the existing conifers are a unit—with Araucaria in some respects (wood and foliage) primitive, but taking cones and all, the most specialized conifer. Earlier I thought differently, partly because I did not understand the cone structure very well, partly because not admitting that Araucaria was without old features or of Mesozoic origin. That was about the view of Seward too.

Let this point be emphasized. In the Paleobotany of to-day and of to-morrow, the fruitful promising fields of research lie in the gymnosperms, ancient and modern. There is the discernible, greater record—the older angiosperm record as yet depending so much on chance discovery. Almost any field of fossil plant research could of course be said to depend on casual discovery of new materials in the field, but in the attempt to gain bettered views of higher seed-plant development the gymnosperms, including the cycadeoids, seem to present the open way. Especially the plants of Rhetic-Oolitic time are far too little known.

It has been just noted that the conifers, while discrete since Carboniferous time, now appear to be a homogeneous group. Also, as distinctly as any "find" that has turned up, the Voltzia subtending bract and sporophylls of Walton seem to indicate the widespread occurrence in old conifer days of a fairly complex axillary shoot, correspondent to a spur shoot but which could also have a relation to a terminal crown. The order of these axes and how they related themselves to the earliest true flowering types can not yet be clear. But evolutionary faith leads to the idea of some very simple relation. The later history of the conifers then becomes a rather open book. The inflorescence theory holds. There is mainly needed to avoid dulling the sharp edge of the new discoveries by failure to consider both age and structure together—appearance in time. Stephanie Herzfeld says:

> I hold it safer, in attempting to prove or disprove the inflorescence theory, to discontinue the attempt to homologize the flowers of both sexes. There are instances where the female flowers are organized into more complicated inflorescences than the male, or *vice versa*, while examples of like order of the flowers of both sexes occur.
>
> Hence the explanation for these variations must be sought for in the history of the phylum. If the conifers were derived from a Torreya-like ancestry, bearing cones with the single flowers inserted on an axis of the third order, as is the case in Torreya to-day, and if the staminate flowers had a similar composition and insertion, then it would not be singular that in the course of later development instances arose in which the staminate inflorescence was simplified (Cupressus, Cunninghamia), more than the ovulate, and other instances in which the reverse took place (Taxodium distichum, Podocarpus macrophylla), or finally those cases in which both sexes have simplified in the same manner (Pinus, Larix, Cryptomeria, Taxus).

The theory of conifer derivation would seem clear if, long ago, following great variation in the pteridosperms with varied phases of monoecism, dioecism and finally fruiting axes of limited growth from megaphyllous types down to minute, there was a period of Cordaite, lax-cone conifer or hemiconifer and varied cycadeoid vegetation, antecedent in close to equal degree to Ginkgos, to specialized conifers, and also to the existing flowering plants, that is, gnetaleans and angiosperms. Those generalized types would, of course, disappear; only the specializing types would come down. The Carboniferous and Permian then would have been the period during which the compact cone conifers and the truer flowering plants, ancient and modern, arose; for the Cycadeoidae flowers must be looked upon as holdover types from the older days of seed plants, though grown much specialized. So too, Gnetum.

Then all seed plants would once have been very much related to each other, with later evolution following two great lines—coniferous and floral. The conifers are now utterly specialized. In them all but the merest recessive traces of the primitive amphisporangiate fruiting shoot are lost and the highest degree of forest specialization in both foliage and flowers has been reached. *Per contra,* the floral types are still plastic, in the emplacement of fruiting organs still primitive; but cosmopolitan, reaching into every environment, they run by way of carpellary fusions and reductions more and more into varied or specialized types easy to recognize as such.

In such a sense the forest canopy would always have presented a certain unity from the most ancient days, would always have been in a condition of unstable equilibrium, or better put, always in a state of response to the changing geologic environment. Conifers would seem older than angiosperms only in the sense that they more rigidly changed. If such a

[4] Stephanie Herzfeld, "Die weibliche Koniferenblüthe," *Oesterreichischen Botanisches Zeitschr.*, 1914.

broadened view does not have in it much of actuality, then theory becomes complex. Then it is too utterly difficult to understand how it is that the best students so often reach the view that the conifer bract and scale are the end results of a leaf or bract, and an axillary shoot. Certainly the short shoot view of bract and scale is a simple view. It relates the cone to the flower in fairly understandable manner; it explains Voltzia as the modified form of the older fertile shoot, and easily undergoing further reduction. It leaves the conifers related to other seed plants in somewhat the same manner as the ungulates are found apposed to other mammalians as the result of digit reduction.

CEREMONY ATTENDING THE OPENING OF DOWN HOUSE, THE HOME OF CHARLES DARWIN

By Dr. JOSEPH LEIDY, II

PHILADELPHIA

THE formal opening of Down House as a public memorial took place on June 7 in the presence of a large and distinguished party as the guests of the president, Sir William Bragg, and officers of the British Association.

Dr. Joseph Leidy, II, represented the American Association for the Advancement of Science; Dr. Edward B. Poulton, of Oxford, and Dr. Henry Fairfield Osborn, president, represented the American Museum of Natural History. The ceremony was attended by upwards of four hundred members of the British Association, friends and representatives of other scientific societies.

Down House lies in the midst of beautiful gardens and orchards in the Kentish Downs, about fifteen miles from London Bridge.

The ceremony was held on the lawn under the presidency of Sir William Bragg, at whose invitation Mr. Buckston Browne formally presented the house into the keeping of the British Association. In the course of a brief address he said that Darwin, like Shakespeare, required no monument. But it might be permitted to them to treasure, preserve and keep sacred always the house that sheltered Darwin—the things in it that he had handled and the grounds he had walked upon. It was this which he (Mr. Buckston Browne) was extraordinarily privileged to accomplish, assisted by Major Leonard Darwin, the surviving son of Darwin, and other members of the Darwin family.

Sir William Bragg thanked Mr. Buckston Browne for his national gift, and accepted it on behalf of the association.

The principal address was delivered by Sir Arthur Keith, F.R.S., on "Science and Sentiment."

Thanks to the munificence of Mr. Buckston Browne we are to-day able to throw open to all the world the home of an English gentleman, Charles Darwin. Henceforth it becomes a national possession entrusted to the care of the British Association for the Advancement of Science. Its rescue was made just in time. In another generation Darwin's home would have gone the way that all human homes go sooner or later; wide-spread decay had set in and Greater London, spreading into Kent, would have eaten up this retreat from which Darwin spoke to the great world of his day.

All danger of such a fate overtaking one of the historical homes of England is now past. Mr. Browne has not only made Down House a national gift; he has repaired it, inside and out, top and bottom; at great personal pains and expense he has restored the chief rooms of the house to the state they were in when Darwin occupied them; thanks to the generosity of the Darwin family and to their ever-ready cooperation, he has been able to place in their appropriate niches pieces of furniture actually used by Darwin and to exhibit personal relics of the great naturalist. Further, he has secured his gift against the ravages of time by an ample endowment for maintenance. Thus to-day a dream which some have dreamt has come suddenly and unexpectedly true. In this little area of the chalky uplands of Kent the nineteenth century will continue to bloom and remain an oasis where our successors, worn with the cares of centuries, may repair for refreshment and inspiration.

Why should this desirable home be withdrawn from active service in the community and be dedicated to an altogether special purpose? It is because there is here enshrined the personality of a great man. Darwin's home is one which we are justly proud to claim as English and which we are convinced our children's children will value as we do. I have no doubt they would have held this generation blameworthy if it had made no effort to save it for them. Our distant successors, I am sure, will be proud of it not so much perhaps on account of the books which were composed and written within its walls but rather, I suspect, because of the personality of the man who wrote them. In the ultimate scale of reckoning, men will always place goodness above greatness; Darwin's was both good and great. It is right that we should stress now this personal aspect of Darwin's life, for the character of no man has been so wilfully travestied in his own century as well as in ours. He was an English gentleman. We have the best of reasons for believing he came of a stock which has lived for more than three thousand years

on English soil; that seems a sufficiently long period to make him English to the core. He was gentle and modest almost beyond parallel; loving and loved in this his home as few men have been; thoughtful for his community, just and charitable even to those who sought to brand him as an enemy of mankind. Down House was an abode of goodness as well as of genius; that is one reason why it should become a national heritage.

It is true that were it merely an English home of the nineteenth century we wished to perpetuate there is a wealth of choice at our disposal, but hardly one, I think, which sheltered such a gifted family as grew up within these walls. We are moved to-day, however, by a purpose which is not bounded by national frontiers. We are honored to-day by the presence of representatives of other countries besides our own. France has sent as her delegate one of her most distinguished men of science—Professor R. Anthony, of the Museum of Natural History, Paris. Our sister society, the American Association for the Advancement of Science, and also the Philadelphia Academy of Natural Sciences, are represented by Dr. Joseph Leidy, whose uncle was the close friend of Huxley and of Darwin. Only an engagement of the most pressing nature has prevented the distinguished president of the American Association—Dr. Henry Fairfield Osborn—from being with us to-day. All our colonies are represented, for the British Association draws its membership from all parts of the empire. Our association represents the commonality of the British peoples.

Thus our ceremony to-day has an international character, and it is right that this should be so. The truth is that Darwin, quite unwittingly, made these few acres of Kentish uplands an international possession. In the place where we are now met, in these grounds, gardens, orchards, meadows and walks and within these walls, were slowly hammered hot from fact new doctrines which radiating out from here slowly penetrated to the ends of the earth, giving humanity a new interpretation of living things and of its relationship to them. Human thought was forcibly and permanently thrust from its old time-honored ruts.

Even more important than his teaching was the manner in which Darwin taught the world from Down. He permitted the bare, unbusked truth to speak for itself; he went only so far as the light of reason would carry him. Only men who teach thus continue to teach for all time. Down House, then, is not a national but an international possession—a common heritage for truth-seekers of all countries and of all centuries.

Mr. Buckston Browne in conveying his gift to the British Association made no stipulations; he did not wish Darwin's home to be bound by the dead hand of the law. He rightly trusted to the good sense of the succession of men who will preside over the affairs of the British Association to carry out certain expressed personal wishes which were (1) that Down House and grounds should be maintained as nearly as possible in the state given to them by Darwin; (2) that the public, irrespective of nationality or of creed, should be given free access to the public rooms and to the grounds. And one condition we have made, that the name of Buckston Browne be associated with the gift—in memory of the donor's beloved son and grandson.

There was another wish expressed by the donor and, to my way of thinking, a very important one. It was the wish that the Council of the British Association would use Down House to advance the cause of science in what way it thinks best. This implied condition enhances the quality of the gift, for no one desires to see British land thrown into permanent fallow or property estranged from lawful use. I shall justify the place of sentiment in science presently but we need not sacrifice more to sentiment than can be fully justified. In what way Down may best serve the advance of knowledge is a matter which will take time to determine. If any place can provide inspiration for research it should be Darwin's own gardens. No doubt, if the council of the association could catch a young Darwin and place him here, history would repeat itself, but then, if the law of chance continues to hold, it may have to wait a millennium before such a treasure is secured. Meantime the council has resolved to install its trusted permanent secretary as resident officer at Down House.

I have said something of Darwin's personality and very little of his science; I have spoken of Down House as a home of reason but I have said nothing of the deeper motives which moved us towards the object now accomplished. What is the reason or motive which has made it so desirable for us to see Down House become a permanent sanctuary for Darwinian pilgrims? We are probably moved by diverse reasons and motives. Let me state my own case. My first visit to Down House made an indelible impression on my memory. I obtained a background for a mental picture in which the living Darwin moved, experimented, thought and suffered—such a picture as no verbal description can give. My gain was that which a historian knows when he has made a personal survey of a battle-field where great issues have been determined. A student will never know Darwin until he knows Down. To see Down is the best way to obtain an introduction to Darwin's works. You can not separate science from personality. If this was my case when I visited Down, I who was born and bred in Darwin's lifetime, what would have been the case of students born centuries hence—if a public-spirited and generous man had not stepped in and saved Darwin's home for them? Its preservation may be regarded by some as a luxury, but are not luxuries the necessary embroideries of a full life?

It is usually supposed that science and sentiment are incompatibles; it certainly is the case that when sentiment enters a laboratory by the back door, science takes the earliest opportunity to escape by the front. And yet men of science, in spite of a wide-spread belief to the opposite, are really sentimental beings at heart. What we do to-day is an open acknowledgment that sentiment has a place in science. We are not dedicating a monument to Darwin's memory; he needs no monument; his works will outlast anything we can build in stone. What we are doing to-day is giving way to a sentiment—a de-

sire, an impulse, an appetite, call it what you will—which is deeply implanted in human nature. What is the impulse which compels grown men and women to besiege the homes and invade the lives of famous authors? Is it not a commendable but misplaced form of curiosity or hero-worship? Is not the prime motive which moves us to-day akin to that which whets our appetite for personal details of the men and women who achieve prominence in politics, art, literature, sport and society? I fear it is. We must confess that we are neither better nor worse than other men. Only in our case there is an excuse—the object of our curiosity is an altogether exceptional man—Charles Darwin. To know him you must first know Down, and for our own good we can not know too much of either.

Dr. R. Anthony, professor of comparative anatomy, Museum National d'Histoire Naturelle, Paris, who occupies the chair formerly held by the immortal Cuvier, conveyed the congratulations of French science.

Dr. Joseph Leidy, II, representing the American Association for the Advancement of Science, spoke briefly for American science. In the course of his remarks he referred to an incident in the life of Darwin which linked America with Down House, which upon this historic occasion may not inappropriately be referred to as bearing upon the early history of science in the United States and Great Britain.

In December, 1859, the first publication of Darwin's "Origin of Species" reached America. Upon the confines of this very spot where the speaker stood, Darwin, in February, 1860, wrote to Joseph Leidy, the American naturalist, the following letter:

DOWN, BROMLEY, KENT.

MARCH 4TH.

Dear Sir:

I received a few days ago your note of December 10th and your most generous present of a whole bundle of your publications which I value most highly and am extremely glad to possess.

Your note has pleased me more than you could readily believe; for I have during a long time heard all good judges speak of your palaeontological labours in terms of the highest respect. Most palaeontologists (with some few good exceptions) entirely despise my work: consequently approbation from you has gratified me much. All the older geologists (with the one exception of Lyell whom I look at as a host in himself) are even more vehement against the modification of species than are even the palaeontologists. I have, however, been equally surprised and pleased at finding that several of the younger geologists, who are now doing such good work in our geological survey, go with me, and are as strong as I can be on the imperfections of the geological record. Your sentence that you have some interesting facts "in support of the doctrine of selection which I shall report at a favourable opportunity" has delighted me even more than the rest of your note. I feel convinced that, though as long as I have strength I shall go on working on this subject, yet that the sole way of getting my views partially accepted will be by sound workers showing that they partially accept them. I say partially, for I have never for a moment doubted that though I can not see my errors, that much in my book will be proved erroneous. Pray forgive this egotistical note and with cordial thanks for your letters and kind present, believe me My Dear Sir, with sincere respect,

Yours obliged
CHARLES DARWIN

In March, 1860, upon the recommendation of Joseph Leidy and Isaac Lea, the conchologist, Darwin was elected a corresponding member of the Philadelphia Academy of Natural Science. Upon the announcement of his election, he wrote Sir Charles Lyell:

MAY 8, 1860.

This morning I got a letter from the Academy of Sciences of Philadelphia announcing that I am elected a correspondent. It shows that some naturalists there do not think me such a scientific profligate as many think me here.

(Signed) CHARLES DARWIN

To the Philadelphia Academy of Natural Sciences, in all probability, belongs the honor of having been the first foreign society to accord this great work official recognition. That Darwin was not unappreciative of the support accorded him by his American friends, this bit of correspondence will attest. The researches in America, in geology and paleontology, which preceded the publication of the "Origin," to be followed in succeeding decades by a whole galaxy of younger investigators, must always stand out as America's contribution towards eliminating that imperfection of the geological record which so disturbed the mind of the great emancipator, Charles Darwin.

We wish, therefore, to forge still stronger this chain which links American science with Down House and this memorial. It is fitting, therefore, that the bust of Charles Darwin, the work of the gifted sculptor, Charles L. Hartwell, R. A., now on temporary deposit in the Royal Academy, should be placed in this shrine to remain for all time as a gift to the British nation, in memory of those American naturalists who came to the support of Charles Darwin upon the publication in 1859 of the "Origin of Species."

To the list of treasures deposited at Down House, in the study in which Darwin wrote the "Origin of Species," there is seen the high chair in which he sat, using as a desk a board placed across his knees. In the center of the room is his work table, and among other relics are his pistols, the telescope he used during the voyage of the *Beagle,* his geological hammer, microscope and many other scientific instruments, the snuff jar which Darwin kept, not in the study but in the hall, in the vain hope of breaking himself of the habit. In addition, there are to be added the fifty-

eight original Darwin letters known as the Müller collection, which is the gift of Professor Henry Fairfield Osborn, president of the American Museum of Natural History, New York.

Nor should we overlook the reference of a contemporary to an important part of the afternoon's proceeding, the "pious" pilgrimage made by every visitor to the kitchen garden and experimental greenhouses, and to the plantation with its "sand" walk where Darwin paced up and down every day swinging his iron-shod stick and meditating on his work.

JOSEPH LEIDY, II

OBITUARY

RECENT DEATHS

JOHN STERLING KINGSLEY, of Berkeley, California, since 1921 emeritus professor of zoology at the University of Illinois, died on the steamship *President Taft,* three days out of Yokohama, and burial was made at sea. Mr. Kingsley, with his daughter, Miss Mary E. Kingsley, was on a trip around the world.

DR. EDWARD BEECH CRAFT, executive vice-president of the Bell Telephone Laboratories, died on August 21 at the age of forty-seven years.

DR. HARRY C. FRANKENFIELD, meteorologist in charge of the river and flood division of the Weather Bureau, died in Washington, D. C., on July 29 as a result of injuries received when struck by an automobile on July 22. One of his most notable contributions to meteorological science was the development of numerical computations by which the flood stages of rivers at different points may be forecast days in advance. Dr. Frankenfield was in his sixty-seventh year.

DR. PETER A. YODER, chemist and sugar-cane technologist in the bureau of plant industry of the U. S. Department of Agriculture, died on July 20 at the age of sixty-two years.

THE death is announced of M. Auguste Lebeuf, since 1903 director of the Observatory of Besançon and a correspondent of the Paris Academy of Sciences.

SCIENTIFIC EVENTS

SCIENTIFIC RESEARCH IN INDIA

THE *London Times Educational Supplement* reports that the Inter-University Board, India, has published a pamphlet showing the facilities for scientific research at Indian universities. This follows a similar pamphlet issued a year ago on the corresponding facilities for Oriental studies. It is interesting to note that, while seventeen chartered and Indian state universities supplied information for the first pamphlet, the number of replies in respect of scientific research is limited to thirteen. The deduction to be drawn is that no definite arrangements are made for scientific research at the remaining universities. It may be noted, however, that, whereas the first pamphlet gave in an appendix some particulars of Oriental research facilities at a few extra-university institutions, such as that at Poona founded by the late Sir R. G. Bhandarkar, the present pamphlet does not include within its scope either the All-India College of Science at Bangalore or the Bose Research Institute at Calcutta.

The reply from Dacca sets forth a number of material advantages for students, among them being reasonable cost, a healthy climate, excellent hostel accommodation, splendid playing-fields, provision for games, students' societies of all kinds and careful medical attendance and supervision. It is added that since the university is residential, the students have the advantage of coming into close touch with the teachers under whom they wish to carry on their investigations.

The Lucknow University, which like Dacca University, came into existence in 1921, claims that its botany department has an advantage not possessed at any other seat of learning in India—that it has on the staff two specially trained men in their subjects, who are both D.Sc.'s of London University. Fossil botany and soil science are subjects in which research is being mainly, if not solely, carried out by this department among the Indian universities. Special attention is being devoted to one aspect of the subject—namely, the coordination of academic work with agricultural and applied botany (including industrial and economic botany). Some of the researches now being carried on in the department have practical bearing on important Indian agricultural problems. The Royal Commission on Indian Agriculture, while recommending that postgraduate training should be essential for candidates from the provincial agricultural colleges seeking higher posts in the agricultural departments, held that such training should ordinarily be given at the Pusa Research Institute, "which, in present conditions, is the only institution in India in which facilities for higher instruction in all branches

of agricultural science are available." In support of this view it was remarked that it would usually be difficult to fit the small number of postgraduate students from the agricultural colleges into the ordinary Indian college system; but it was recognized that, as the scientific side of the universities develops, they may be expected to provide more facilities for postgraduate study in pure science.

The Benares Hindu University makes strong claims to an advanced position in the matter of scientific research. The chemical laboratory is a modern fireproof two-storied building, with thirty-four big rooms, including two big lecture theaters and a small lecture room. Special facilities are provided to enable competent students to conduct original investigations. The student, under the guidance of the professor in charge, undertakes for an extended period a comprehensive investigation of some problem in chemistry of theoretical or practical significance. Ordinarily the standard and the scope of these researches is that necessary for the award by the university of the doctorate of science.

In Southern India some progress is being made. The Madras University has adopted schemes for the establishment of research laboratories in zoology, botany and biochemistry. Suitable sites for the construction of the proposed laboratories have been selected, and detailed plans and estimates are under preparation, temporary arrangements being made for research work in the meantime. The new Andhra University is associated with the Madras University in awarding studentships tenable in the laboratories of its college at Vizianagram for research in spectroscopy. The research department, founded by the Raja of Vizianagram, is specially well equipped for this subject. The Mysore University has the advantage of some coordination of its work in certain branches, notably that of geology, with the All-India College of Science at Bangalore.

THE AUSTRALIAN ANTARCTIC RESEARCH EXPEDITION

THE prime minister of the commonwealth has recently made in the Australian Parliament the following statement, which is quoted in the *Geographical Journal,* London:

> Having given the closest and fullest consideration to the question for several years past, the commonwealth government has reached the conclusion that the time is now ripe for an Australian expedition to proceed to that part of the Antarctic which lies immediately to the south of Australia. It has therefore decided to organize and equip such an expedition, which, it is at present contemplated, will leave Australia towards the end of this year. In view of his great experience and knowledge of Antarctic conditions and his world-wide reputation in scientific circles, we have approached Sir Douglas Mawson and asked him to lead the expedition. Sir Douglas has informed us that he will be prepared to do so. The special interest of the commonwealth in the Antarctic region lying south of Australia, extending from the Ross Sea in the east to Enderby Land in the west, which is generally known as the Australian sector, has been often affirmed in the past. Of the various expeditions to this region, the richest so far in scientific and other achievement was Sir Douglas Mawson's expedition of 1911–14. The expedition that the commonwealth government has decided to organize this year will, it is hoped, complete and crown this previous Australian effort.
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> His Majesty's government in Great Britain has generously placed the *Discovery* at the disposal of the expedition, free of charge. This vessel is at present in the service of the Falkland Islands Dependencies, and has been specially constructed for work in the ice. It is the best ship at present afloat for the purposes of the expedition.
>
> The forthcoming expedition will seek to effect a variety of objects, mostly of a scientific nature. The exploration and mapping out of that part of the coast-line which could not be completed by the Mawson expedition in 1911 will be undertaken, scientific and meteorological work will be carried out, investigations into the economic resources of the region will be made.
>
> The exact location of the coast-line of this sector of the Antarctic in which Australia is interested is of material importance. The expedition will therefore carry out hydrographic survey work, comprising the correct location and charting of coasts, islands, rocks and shoals. It is proposed to equip the expedition with aeroplanes so that inland surveys can be made. The study of meteorological conditions which will be made will enable the relationship between these conditions and the climate and weather of Australia to be determined more adequately than at present. A further important part of the expedition's work will be to carry out investigations regarding the fauna, notably whales and seals, of the region explored. Whaling in various parts of the Antarctic, notably south of the Falkland Islands, New Zealand and South Africa, has now assumed considerable importance, and the government feels that it is most desirable that investigations should be made in the near future to determine the economic and commercial value of the waters of the Australian sector in this respect.

Sir Douglas Mawson, who was for some months in England on the business of the expedition, has now returned to Australia, leaving Captain J. K. Davis to take out the *Discovery* in August next. The *Geographical Journal* understands that the ship is lent to the Australian by the British government, which has rented her from the Falkland Islands government, and that a new and larger ship is now being built for the research work of the Falkland Islands Dependencies.

THE UNIVERSITY OF KENTUCKY BOTANIC GARDENS

AFTER nearly a year of active work under the direction of Harry Lindberg, landscape gardener for the University of Kentucky, the botanic gardens, comprising a tract of about nine acres of the university campus, are rapidly nearing completion. The combined efforts of the university and the Lexington Garden Club brought about realization of this plan, and last summer a sum of money was made available with which to begin the work.

It is the ultimate aim of the university to have in the garden every type of plant which will grow in this climate. Already several rare plants have been secured, and the largest collection of hybrid rhododendrons in the state has been planted. The rhododendrons require a special soil, which has been prepared for them by the use of peat moss and aluminum sulphate. One of the features of the gardens is an Italian cypress, donated by C. E. Buiiage. This was grown by the California Department of Forestry, from seeds gathered in the garden of Gethsemane.

The plot is divided into three parts. The first division contains the rock garden, and foreign trees and shrubs. Rocks for this part are of Kentucky limestone, and were obtained from the Kentucky River cliffs near Wilmore. Flagstone walks, stone benches and stone piers at the entrance make this a spot of special scenic beauty. The second division contains those plants needing special soil, and also water and bog plants. Two pools have been excavated in this part of the garden. The third part of the garden is given over exclusively to native trees and shrubs.

It is hoped that eventually a tract of land large enough to establish an arboretum will be developed. This would contain all the native trees and shrubs as well as all exotic woody plants that can be grown in this state.

Contributions of many Kentucky nurseries and many out of state made possible the establishment of the botanic gardens. Among those from Kentucky who contributed plants were the Dixie View Nurseries, of Covington, the Donaldson Nurseries, of Sparta, the R. L. Haag Nurseries, of Jefferstown, the Highland Place Nursery, of Versailles, the Hillenmeyer Nurseries, of Lexington, the Louisville Nurseries, of St. Matthews, the Jacob Schultz Company, of Louisville, and the Willadean Nurseries, of Sparta. Contributions from the states of Pennsylvania, New Jersey, Alabama, Georgia, New York, Illinois, Tennessee, Massachusetts, Iowa and Ohio have also been received.

The University of Kentucky Botanic Gardens are open to the public.

HONORARY DEGREES AT YALE UNIVERSITY

AT its recent commencement exercises, as already noted in SCIENCE, Yale University conferred honorary degrees on four scientific men. The citations were as follows:

Richard Thornton Fisher, M.S.

Professor Phelps: Although a graduate of Harvard College, Mr. Fisher became a missionary from Yale to Harvard. Always alert and ambitious, he was one of the American pioneers in forestry and showed good judgment in entering the Yale Forest School as soon as it was opened, taking his degree in forestry with the earliest class in 1902. Three years later, when Harvard imitated Yale and established a department of forestry, Mr. Fisher was naturally chosen as its head. Later he became director of the Harvard forest at Petersham, and by his records of growth and cut, he has disproved the common proverb that "you can not see the forest for the trees."

President Angell: A member of the first class to graduate from her pioneer Forest School, Yale University has observed your significant career with increasing pride, and now, in recognition of your enduring achievement in promoting public interest and confidence in sound methods of forestry, as well as for your distinguished service in developing high professional standards for the training of men in forest science, she confers upon you the degree of master of science and admits you to all its rights and privileges.

William Hallock Park, Sc.D.

Professor Phelps: Professor of bacteriology and hygiene, University and Bellevue Hospital Medical College, New York University. The laboratory organized by Dr. Park was the first in the world in which the new discoveries of Pasteur and Koch were systematically applied to the protection of public health, and for thirty-five years it has remained, under all political changes, a model scientific institution. Dr. Park has been a pioneer in the discovery of the part played by well carriers of disease germs in the spread of communicable disease, and has contributed more than any other living man to the development of the technique of bacteriological diagnosis and serum treatment which has made possible the conquest of diphtheria. He thus has the double satisfaction of being successful in original research and successful in his fight for the health of his fellow creatures. He is a perfect type of the scientist in the service of the state.

President Angell: In grateful recognition of your long years of wise and devoted service to the improvement of the public health, which has resulted not only in a conspicuous betterment of conditions in the metropolitan community for which you have immediately labored, but also in the promotion of a more alert and intelligent dealing with the crucial problems of public hygiene the country over, and not less than for your notable work of scientific research, Yale University con-

fers upon you the degree of doctor of science and admits you to all its rights and privileges.

Arthur Holly Compton, Sc.D.

Professor Phelps: Professor of physics at the University of Chicago. Born in Ohio, a graduate of Wooster College, taking his doctor's degree in physics at Princeton, Dr. Compton has been professor of physics at Chicago since 1923. In 1927 he was awarded the Rumford gold medal by the American Academy of Arts and Sciences. In the same year he received the Nobel prize in physics. He has positive genius as an experimenter. Everything he undertakes has been so carefully planned that significant results have followed, sooner than any one has a right to expect. He has made a brilliant contribution to the theory of light. From work on the scattering of X-rays by electrons he has obtained a striking confirmation of the idea that light has a corpuscular nature as well as a wave form. More recently his work on the diffraction of X-rays by gratings has led to new values of the electronic charge and of Planck's constant, which may ultimately lead to important theoretical developments.

President Angell: In recognition of your notable discoveries in the field of fundamental physical science, whose revolutionary implications are still but partially fathomed—discoveries achieved at an age when many men are just completing an apprentice training—and in the confident belief that your future career will be increasingly brilliant and fruitful, Yale University confers upon you the degree of doctor of science and admits you to all its rights and privileges.

Arthur Holly Compton, Sc.D.

Professor Phelps: The grand old man of surgery. Born in the prehistoric year of 1836, he took the degree of doctor of medicine at P. and S. in 1861. After five years in Germany he enjoyed a wide practice as an oculist, and later became an adept in major surgery where his language was as keen as his instruments. For forty-four years he was a member of the American Surgical Association, and at one time its president. As a professor in the Yale Medical School in the dark hours before the dawn, he visualized the proper development of the school of medicine and labored in the face of many obstacles for the correlation of Yale University and New Haven Hospital, and, "when the thing that couldn't had occurred," he saw the travail of his soul and was satisfied. He was a curious combination of the most advanced methods in science with the most conservative methods of transportation. A visitor to our city remarked that New Haven was a one-horse town. It was a one-horse town, and Dr. Carmalt had the horse. He was beloved by his patients, respected by his colleagues and esteemed by his fellow citizens, both for his skill and for his downright sincerity.

President Angell: Endowed with remarkable mental and physical vigor, he has built his life, now approaching its centenary, into the very fabric of the community he has so faithfully served. He has lived to see the Yale School of Medicine and the New Haven Hospital, to both of which, amid difficult and discouraging conditions, he has given so many years of his life, develop into powerful institutions of the very first class. His unflagging devotion to the promotion of sound and progressive methods in medicine and surgery has justly brought him wide recognition and respect. Yale University regards it an honor to confer upon him, as a wise and intrepid leader in the community and in the nation, the degree of doctor of laws and to admit him to all its rights and privileges.

SCIENTIFIC NOTES AND NEWS

THE William H. Welch Medical Library and the department of the history of medicine of the Johns Hopkins University will be dedicated on October 17 and 18. The dedication of the medical library will be made by President Joseph S. Ames, with an address by Professor Harvey Cushing, of Harvard University. The department of the history of medicine will be inaugurated by Professor Welch, and an address will be given by Professor Karl Sudhoff, of the University of Leipzig. In connection with the dedication there will be conferences on medical libraries and on the history of medicine.

THE honorary degree of doctor of laws has been conferred by Glasgow University upon Madame Curie.

THE University of Durham has conferred the honorary doctorate of science on Sir Frank Dyson, astronomer royal.

A PROFESSIONAL degree in civil engineering was conferred by Iowa State College upon Professor H. S. Carter, head of the civil engineering department of South Dakota State College.

THE British Institution of Mining Engineers has conferred on George S. Rice, chief mining engineer of the U. S. Bureau of Mines at Washington since its formation in 1910, the institution's medal "in recognition of his eminence in all matters relating to the safe working of coal mines."

DR. H. B. Herrick, formerly chief surgeon under General Gorgas in the Panama Canal Hospital and now carrying on a private practice in Panama City, has been decorated with the "Medal to Merit" by the government of Ecuador through its legation. The distinction, which is the highest awarded by Ecuador, was given to Dr. Herrick in recognition of his surgical skill.

THE proceeds of the Daniel-Pidgeon Fund for the year 1929 have been awarded by the council of the Geological Society of London to Mr. J. Selwyn Turner, who proposes to investigate the faunal suc-

cession in the Coomhola Grits and Carboniferous Slate of County Cork.

DR. H. JUDSON OSTERHOF, who has been with the department of engineering research of the University of Michigan, has accepted a position as research physical chemist with The Goodyear Tire and Rubber Company, at Akron, Ohio.

DR. JAMES C. SMALL, director of laboratories, Philadelphia General Hospital, has resigned, effective on September 1. Dr. Small will continue his research in rheumatic diseases and will also engage in private practice of medicine.

DR. M. E. HURST, of Brown University, formerly instructor in mineralogy and petrography in the department of geology, has accepted a position with the Ontario Bureau of Mines.

DR. MAX S. RABINOWITZ, house surgeon in orthopedics at the Hospital for Joint Diseases, New York City, has received that institution's third annual scholarship of $2,400 for specialized study. The scholarship was founded by the late Dr. Henry W. Frauenthal and provides for a year's study, equally divided between Europe and the United States. The recipient is expected to write a thesis on some special phase of his year's work.

THE Lamme Memorial Scholarship, providing for a year of research work, has been awarded to L. R. Ludwig, of Wilkinsburg, Pennsylvania, by the Westinghouse Electric and Manufacturing Company. The award will be made annually in honor of the late Benjamin Garver Lamme, chief engineer of the Westinghouse company. Mr. Ludwig will study in the Technische Hochschule, at Charlottenburg, Germany.

E. B. SANIGAR, junior investigator in electro-metallurgy in the University of Sheffield, has been awarded by the American Electro-Chemical Society the Edward Weston fellowship in electro-chemistry. He has elected to hold it at Columbia University. He has been engaged on research work in silver plating.

THE Medical Research Council of Great Britain announce that on behalf of the Rockefeller Foundation they have made the following awards of traveling fellowships for the academic year 1929–30: Olive Burton Buckley, King's College Hospital, London; Dr. George Aleck Crocker Gough, National Institute for Medical Research, London; Dr. William Robert Henderson, Royal Infirmary, Edinburgh; Dr. Donald Hunter, assistant physician, London Hospital; George Eric Lewis, London Hospital; Moses Myer Suzman, College of Medicine, Newcastle-upon-Tyne, and Janet Maria Vaughan, University College Hospital, London. Dr. Gough's fellowship is tenable at the University of Munich, the others at centers in the United States. Dr. Lewis has been appointed on modified conditions while receiving emoluments from another source.

DR. VERNON L. KELLOGG, secretary of the National Research Council, has been appointed a member of the committee to advise the director of national parks on matters of educational policy and development.

APPOINTMENT of a communications committee to study proposed legislation involving wire and wireless control is announced by the American Engineering Council. The chairman is Edwin F. Wendt, of Washington, D. C. Other members are: O. H. Caldwell, New York, federal radio commissioner; Dean Dexter S. Kimball, Cornell University; Frank A. Scott, Cleveland, and Charles B. Hawley, Washington, D. C.

THE jury appointed by the International Committee of the Red Cross to make the award in the international competition for the discovery of a detective reagent for yperite is made up as follows: F. Haber, Sir William J. Pope, F. Swarts and G. Urbain. The jury will meet in April, 1931, at Paris to examine the proposals, conduct tests on those which seem likely to meet the conditions and will then make the award to one or more of the competitors.

Professor V. C. Finch, of the department of geography at the University of Wisconsin, is making studies in the Peace River region in Canada. His purpose is to observe how the settlers, 500 miles north of the United States boundary, are adapting themselves to the conditions of their environment, their mode of housing, the site of their farmsteads and similar problems.

PROFESSOR P. S. KUPALOV, staff member of the laboratory of Dr. Ivan P. Pavlov at the Institute of Experimental Medicine in Leningrad, has been during the summer engaged with Howard S. Liddell, assistant professor of physiology at Cornell University, in research on the problems of conditioned reflexes. Professor Kupalov is working under a grant by the Heckscher Foundation.

R. D. CANAN, assistant professor of dairy husbandry at Purdue University, has resigned, effective on September 1, to assume charge of the educational work in production of the National Dairy Products Corporation, of New York City.

PROFESSOR C. W. BROWN, head of the department of geology at Brown University, is on leave for the first semester. He will visit Hawaii and Japan, attending the International Power Conference in the latter country. During his absence Dr. Bradford Willard will be acting head of the department. Dr. Willard has now returned from his summer's work

with the Pennsylvania Topographic and Geological Survey, during which time he was engaged in a detailed study of the Silurian rocks of Pennsylvania.

PROFESSOR R. H. WHITBECK, of the department of geography of the University of Wisconsin, leaves in October to make a geographical study of the region about the Caribbean Sea.

DR. E. E. CLAYTON, in charge of plant disease investigation on Long Island for the New York Agricultural Experiment Station, sails on September 7 for seven months in Europe. He will make a study of cruciferous crop diseases in Denmark and Holland and conduct special research work under Dr. V. H. Blackman, of the University of London.

DR. CARL E. LADD, director of extension in the State College of Agriculture at Cornell University, sailed on August 16 for England where he will attend the first International Conference on Agricultural Economics at Dartington Hall, Devon.

E. M. LOEB, lecturer in anthropology at the University of California, has returned from a year spent in Europe as a Guggenheim fellow. He has been making a study of Sumatra and adjacent islands.

ASSISTANT PROFESSOR PERRY BYERLY, University of California seismologist, has returned from England, where he spent the better part of a year studying the dispersion of surface earthquake waves with Dr. Harold Jeffreys, of Cambridge University. In addition to his study at Cambridge, Professor Byerly visited a number of seismological stations in continental countries and in England.

F. C. ELFORD, first vice-president of the World Poultry Congress of 1930, accompanied by Mr. P. A. Francis, poultry commissioner of the Minister of Agriculture and director of the congress, Mr. W. A. Schleit, representing the congress committee of the United States, and Mr. W. W. Baird, of the Nappan Experimental Station, Nova Scotia, left London last week on a six-weeks' continental tour in the interests of the congress. The tour is of an official character and is undertaken in order to obtain as much support as possible from countries which have evinced interest in the congress. The itinerary includes Paris, Lisbon, Madrid, Barcelona, Genoa, Rome, Milan, Berne, Zurich, Munich, Prague, Vienna and Budapest; and it is possible that it may be extended to include the Balkans, Palestine and Egypt.

THE U. S. Civil Service Commission states that the date of the close of receipt of formal applications for the position of assistant technical director (chief chemist), Chemical Warfare Service, Edgewood Arsenal, Maryland, has been extended to October 2.

MR. KEMP, the Union Minister for Agriculture, opened the Pan-African Agricultural and Veterinary Conference in Pretoria on August 1.

PLANS are being completed for the Ninth Congress of Industrial Chemistry, to be held at Barcelona, Spain, October 13 to 19, 1929. The honorary executive and general committees have been appointed, and the King of Spain has consented to accept the honorary presidency of the congress. Six groups, comprising seventeen sections, will hold meetings on October 14, 15, 16 and 17. October 18 and 19 will be devoted to excursions and industrial visits. Detailed information may be obtained from the Society of Chemical Industry, 49, Rue des Mathurins, Paris (8), France.

THE fourth International Congress of Archeology will be held in Barcelona from September 23 to 29.

Industrial and Engineering Chemistry reports that the executive committee of the German Society of Rubber Chemists and Engineers has extended to the members of the rubber division of the American Chemical Society an invitation to attend its next meeting, which will be held in Frankfurt-am-Main on June 8 and 9, 1930, in connection with the annual meeting of Verein Deutscher Chemiker. By vote of the executive committee of the rubber division this invitation has been accepted.

ORGANIZATION of the Pan-American Institute of Geography and History will be effected at a conference planned to be held at Mexico City. Historic and geographic organizations of nearly all the republics of the Western Hemisphere will send delegates to the conference, including the American Geographical Society of New York, the Geographic Institute of Rio de Janeiro and the Mexican Society of Geography and Statistics. Dinners will be given by President Portes Gil and other government officials. Visits will be made to near-by sites of archeologic and historic interest. Clarification of boundary problems between American republics will be one object of the new organization. Sessions will be conducted in Spanish, English, French and Portuguese.

THE British Medical Research Council announces that it is about to begin publication of a "System of Bacteriology in Relation to Medicine," which will be issued in nine volumes, each of some 400 pages.

THE Pacific Science Congress at Java recommended the exchange of earthquake data between Pacific countries at monthly intervals to facilitate their study; that oceanographic stations be established in the various lands contiguous to the Pacific Ocean as a means of ensuring a complete international survey of all phases of this great body of water, and an inten-

sive survey of the structure of coral reefs in the Society Islands.

THE National Metal Congress will be held in Cleveland the entire week of September 9 by the American Welding Society, the Iron and Steel Division of the American Institute of Mining and Metallurgical Engineers, the Iron and Steel Division of the American Society of Mechanical Engineers, the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers and the American Society for Steel Treating. The schedule provides for most of the plant inspections in the mornings, so that the afternoons will be free to attend the metal exposition in the Public Auditorium of Cleveland.

PRESIDENT HOOVER, by recent executive order, has set aside as a refuge and breeding ground for birds, Snake Key, Dead Man or Bird Key and North Key, in the island group known as Cedar Keys, off the west coast of Florida. The refuge will be known as the Cedar Keys bird refuge and will be administered by the Bureau of Biological Survey of the U. S. Department of Agriculture. The islands in the new reservation serve as important nesting and wintering grounds for hundreds of aquatic birds, including several species of herons, pelicans and cormorants, some of which are becoming greatly depleted in numbers. It is unlawful within the refuge to hunt, trap, capture, wilfully disturb or kill any wild animal or bird, or to take or destroy the eggs of any wild bird; to cut or burn any timber, underbrush, grass or other natural growth; wilfully to leave or suffer fire to burn unattended near any timber or other inflammable material; to leave a fire near any forest or timber; or wilfully to molest, injure or destroy any property of the United States.

THE Forest Reservation Commission established by Congress to be guardian over the national forests east of the Mississippi River has authorized the purchase of 111,238 acres to be added to 14 forests in 11 states and has designated six new purchase units in four states. The total purchase price is set at $296,977.96, an average of $2.67 per acre. Funds for the additional tracts are appropriated under the Weeks and McNary-Clark Acts. The national forests already established which will receive additional territory under the new purchase are as follows: Alabama National Forest, Alabama; Allegheny National Forest, Pennsylvania; Cherokee and Georgia National Forest, Georgia; Tawas, Mackinac and Marquette National Forests, Michigan; Monongahela National Forest, West Virginia; Natural Bridge and Shenandoah National Forests, Virginia; Superior National Forest, Minnesota; White Mountain National Forest, New Hampshire; Ozark National Forest, Arkansas, and Savannah National Forest in North Carolina, South Carolina and Georgia. The six new purchase units authorized by the commission are to be known as Oneida National Forest, in Forest Vilas and Oneida Counties, Wisconsin; Flambeau National Forest in Price County, Wisconsin; Moquah National Forest in Bayfield County, Wisconsin; Geweenaw National Forest in Iron and Houghton Counties, Wisconsin; St. Croix National Forest in Pine and Carlton Counties, Minnesota, and Green Mountain National Forest in Windsor, Bennington and Rutland Counties, Vermont. The latter will be Vermont's first national forest.

THE Bureau of Standards reports that a new process for the production of large disks of optical glass will be described in the August number of its *Journal of Research*. This process was developed by the bureau's glass section in connection with the making of the 70-inch disk for the mirror of the large reflecting telescope at Ohio Wesleyan University. The raw materials were melted and stirred in a large pot, which was then tapped near the bottom. The molten glass flowed through an iron trough into a combined mold and annealing furnace located in a pit in front of the furnace. The temperature was accurately controlled by electrical means; the whole period of cooling and annealing occupied 8½ months. The resulting disk proved to be remarkably well annealed and no difficulty was experienced in drilling an eight-inch hole at the optical axis to accommodate the Cassegrainian mounting. The paper will describe the method of making the pots, modifications in the construction of the melting furnace, the arrangement of the mold and annealing furnace, the methods of measuring and controlling temperatures, the melting and casting of the glass, the method of annealing the glass, the determination of the quality of the annealing and the drilling of the hole at the center of the disk.

THE National Research Council has received a fund of $10,000 for a cooperative investigation with the Bureau of Standards on the preservation of publications. The investigation planned consists of surveys in public libraries to find the existing conditions as to the deterioration of publications and to find means of remedying conditions found to be harmful. Consideration will be given to all materials used in books and to the influence of the atmospheric conditions in libraries. Librarians and others concerned with the preservation of valuable records published in book form have noted with considerable alarm the rapid deterioration of many such publications, and there has sprung up a general demand for accurate information which will assist in developing measures to prevent deterioration.

A CORRESPONDENT of the *Journal* of the American Medical Association reports that an institute of preventive medicine has been established at Leyden, the first of the kind to be created in the Netherlands. On the administrative committee will serve Mr. W. J. M. Van Eysinga, professor at the Faculté du droit and rector of the University of Leyden; Mr. P. I. Idenburg, general secretary Professor Dr. J. A. Barge, of the faculté de médicine; Professor Dr. E. Gorter, of the faculté de médicine, and Dr. M. D. Horst, director of the medical service at Leyden. The institute has a threefold purpose: (1) the application of preventive measures to diseases; (2) the study of new problems of preventive medicine, and (3) the instruction of physicians and nurses, together with responsibility for publicity campaigns. The society will occupy itself particularly with prenatal care, the care of infants, children of preschool age, and school children, and the care of adolescents and adults. In addition, the institute will study, as far as possible, the prophylaxis of occupational diseases. At the start, only a part of the program can be carried out, but it is hoped that, with the aid of subscriptions, it will soon be possible to realize the entire program. The administration is composed of five persons, while the general committee comprises at least sixty members.

UNIVERSITY AND EDUCATIONAL NOTES

DR. CLARENCE STONE YOAKUM, director of the bureau of university research at the University of Michigan, has been appointed dean of the college of liberal arts at Northwestern University.

ASSISTANT PROFESSOR H. M. GEHMAN, of Yale University, has been appointed head of the department of mathematics at the University of Buffalo.

DR. W. H. CHANDLER, professor of pomology in the college of agriculture at the University of California, has been appointed head of the division of pomology. Dr. Chandler succeeds Dr. W. L. Howard, who has been appointed director of the branch of the College of Agriculture at Davis.

IN the school of chemistry at the University of Minnesota, Dr. George Glockler has been appointed associate professor of inorganic chemistry to replace Dr. R. E. Kirk, who becomes head of the department of chemistry at Montana State College; Dr. D. S. Villars replaces Dr. N. W. Taylor, who has leave of absence for 1929–30 to study in Berlin under a Guggenheim fellowship. Dr. R. E. Montonna has been promoted to an associate professorship of chemical engineering.

A. W. QUINN has been appointed instructor of mineralogy and petrography in the department of geology of Brown University. Mr. Quinn was with the U. S. Geological Survey during the past summer. He takes the place of Dr. M. E. Hurst, who has joined the staff of the Ontario Bureau of Mines.

DR. BENNO E. LISCHER, professor of orthodontics, Washington University, St. Louis, from 1901 to 1924, and since then special lecturer in orthodontics at the University of Michigan, has been appointed professor of orthodontics in the University of California.

PROFESSOR H. H. WOOLLARD has been appointed as from September 1 to the university chair of anatomy tenable at St. Bartholomew's Hospital Medical College, London.

MISS ELLEN GLEDITSCH has been promoted to a professorship in chemistry at the University of Oslo, where she has been an associate professor since 1916.

DISCUSSION

QUALITY VERSUS QUANTITY IN UNIVERSITY FACULTIES

IN SCIENCE for July 12 and 19 appear papers on the economic status of American university teachers by Professor B. R. Andrews, Dr. F. P. Bachman, Professor R. H. True and Professor H. F. Clark. These papers are from the symposium at the last annual meeting of the American Association for the Advancement of Science. Together with the report of Mr. Trevor Arnett, of the General Education Board, and the studies at the University of California by Peixotto and at Yale, these contributions make an extensive discussion of this subject.

As one who worked hard on one of these studies,[1] I venture to say that it is all wasted effort unless the members of the teaching profession obtain from it a clear understanding of what they have to do, both individually and through academic public opinion, if salaries are to go up. And salaries must go up if there is to be improvement, and not deterioration, in the quality of university teaching and particularly in the quality of university teachers.

Certainly our colleagues now have generally no such effective understanding of the essential elements in the situation. Only a day or two ago I heard one of them from a sister university express appreciation of the Yale study, together with the hope that it would influence salaries at his own institution. But in the next sentence he stated, and with evident satisfaction, that in the undergraduate school of his university the

[1] "Incomes and Living Costs of a University Faculty," edited by Yandell Henderson and Maurice R. Davie, Yale University Press, 1928.

tutorial system is to be introduced on a broad scale. Like the majority of our colleagues in all American colleges and universities he wants both to increase the number of the faculty and to have higher salaries. But the Yale report in its most important, and unfortunately least-noticed, section proved with mathematical decisiveness that the reason why the enormous sums of money which are annually added to the endowment of our educational institutions produce only a sluggish upward movement of salaries is that the number of salaried teachers is increased in nearly the same proportion as are the funds available for salaries.

Higher intellectual quality in the teachers is the most important element in better teaching. No new educational devices, however meritorious in themselves, such as the tutorial system, residential halls with separate staffs, etc., can contribute to the education of large bodies of students to a degree comparable with a few able teachers. A generally higher quality can be obtained only by a much higher salary scale. Therefore, the greatest improvement in our universities involves holding the faculties at approximately their present size until funds accumulate sufficient for higher salaries. So enormous are the sums now annually poured into our universities that there are few institutions which, if they met this condition and limited the increase in the faculty, would not be enabled within a decade to raise all salaries 50 to 100 per cent. At that higher level of salaries and ability new educational devices could be introduced with a much greater chance of proving effective than on the present level of salaries and ability.

This proposal, however, runs head on into collision with the idea, now prevalent, that college students can be taught effectively only in small classes. This idea is generally offered as the reason, or excuse, for the enlargement of the faculties to keep pace with the increase of students. Doubtless the highest grade teaching should be done in small classes or even tutorially. Doubtless the most valuable man is the productive scholar. Certainly there are many valuable teachers who lack the exuberant personality requisite to hold large classes. Yet surely not all teaching even in the large general subjects must necessarily be done only in small sections. If the small class, or rather the small division of all large classes, is carried much further than at present, the outlook for higher salaries is hopeless. University salaries are now at the level that mediocrity commands in other callings, and the intellectual level tends toward equality with that of salaries. The small-class idea is bringing into the faculties an increasing proportion of men who would be usefully employed as teachers in high and preparatory schools. They lack both the productive and the erudite impulses in scholarship. They have neither the personality nor the energy to teach a class of more than a few college students. They obtain university positions merely because of the demand for many teachers and the low requirements as to ability for teachers of small sections in general and elementary subjects.

Fortunately, neither low salaries nor the small-class trend nor the diminishing demand for teachers of vigorous personality have as yet entirely eliminated from college faculties men capable of teaching moderate-sized or even large classes effectively. Although such men are often too active-minded to achieve the most fundamental work of scholarship, yet because of their inherent energy they rarely fail to become leaders of their generation outside as well as within academic walls. At present, instead of being encouraged to teach large classes, such men are often made to keep step merely with the small-class teachers, lest the difference in the two types, the mediocre and the able, should be too evident.

The possibility of higher salaries, so far as the faculty can influence it, depends wholly on covering a larger number of student-hours per week with fewer, or at least without more, teachers. It is, therefore, strongly in the financial interest of the faculty as a whole to decrease the small-class type of teacher, except when he shows distinct scholarly ability, and to encourage every teacher, without increasing his courses or his hours in the classroom, to teach as large classes as he can efficiently.

But even this increase of the student-hours per teacher will effect only a sort of retail improvement in the salary situation. The wholesale side of the problem is one for which the responsibility rests on the higher executive officers and trustees of each university. There is public jubilation when funds for the addition of another school or institute in the university are announced. But for the faculty, and for those who desire improvement in the quality of the faculty, such additions should often be rather a cause of regret. Unless there is a clear and urgent need for the education and the research which the new school or institute may afford, it inevitably does more harm than good to the university and to general cultural advancement. By enlarging the faculty it renders any future sums for raising the level of salaries and ability proportionally less effective. Perhaps aviation is the next field in which such incompletely endowed schools will be added to our universities. It is highly probable that there is no university in the country in which funds devoted to this, or to any similar new educational enterprise, would not be more usefully employed in improving the already existing departments.

The essential point is that our universities are already vastly overextended, and yet they are continu-

ally being extended further. A railroad or factory which followed such a policy and allowed the quality of its staff to deteriorate, while continually absorbing new capital and expending it on new lines instead of on strengthening those already existing, would inevitably go bankrupt.

Let us face the facts. The universities are not now attracting ability into their faculties. Exceptions occur, but this is the rule. If the universities want a higher intellectual level, they will have to pay for it.

What, then, are the market prices of ability, mediocrity and inferiority? The Yale report shows that, as a general rule, at least in cities where it snows in the winter and houses have to be heated, the total annual living expenses of any family are about half the sale value of their residence. This rule applies fairly closely to the various grades of professional and business men, to clerks, mechanics and laborers, as well as to professors. It rests on the facts that 20 per cent. of the total annual expenditure of a household, or a little more, always goes for rent, real or virtual, and that a house or apartment rents for about 10 per cent. of its sale value. Thus a man's annual salary is about half the sale price of the house he can live in comfortably on that salary, and provide for his family.

From these relations it follows that, if a university wants a certain level of ability on its faculty, it is only necessary to get from the tax assessor's office the values placed on the houses in which live the economic class with that level of ability. It may be that of the leading lawyers, doctors, bankers and business men of the town, or merely the general run of the legal and medical professions; or bank clerks; or policemen; or day-laborers. Whichever it is, half the valuation of their homes is the approximate market price in that town for the corresponding level of ability.

Application of this principle to the present salary scales in our universities reveals the underlying cause of the increasing demand for "better teaching." This need is not met, but is rather increased, by each additional million now devoted to expansion. More teachers for smaller classes, new educational devices, additional departments, schools and institutes, larger and more imposing universities are all poor substitutes for a faculty of a high level of intellectual energy.

YANDELL HENDERSON

YALE UNIVERSITY

ROUNDSTONE, A NEW GEOLOGIC TERM

EARLY in 1918, in the course of my work in the editor's office of the U. S. Geological Survey, I jotted down half a dozen quotations that showed considerable differences among geologists in the use of the words boulder, cobble, pebble and occasionally gravel, to indicate sizes of rounded fragments. Four years later C. K. Wentworth published in the *Journal of Geology* his schedule of grade terms, which is a sufficient guide to uniformity in that respect.

I wish to offer now, from my notes of 1918, the new term *roundstone* as a generic term to include the largest four sizes in Wentworth's schedule, boulder, cobble, pebble and granule. This term would be useful to designate the unassorted accumulations composed of two or more sizes of rounded stones that occur in many situations. It could fill the place incompletely filled by two or three terms in such statements as "all the pebbles and boulders are within a few feet of the surface"; "the largest patches contain gravels and cobbles at the base," and "the pebbles, cobbles and boulders were collected in groups of ten to seventy."

FREDERIK A. FERNALD

THE USE OF PARADICHLOROBENZENE IN THE CONSERVATION OF HERBARIA

DURING the past years we have been using paradichlorobenzene in substitution of naphthalene, in the conservation of the phanerogamic and mycological Herbaria of the Agronomical Station, with excellent result.

This substance, contained in test-tubes, was placed upon each drawer of the iron boxes, but there is no inconvenience in dusting it directly upon the plants placed on the Herbaria boards.

A comparative experiment was made with samples of *Cassia* and *Tipha*, which get easily damaged in the Herbarium.

Having dried some specimens and divided them into three lots, they were set in a place exposed to dust and moths. A first lot was left without any preserving substance; a second one was placed together with naphthalene dust on the cardboards, and the third one with paradichlorobenzene—the two latter with the same amount of preservative, by weight.

At the end of a year, the samples left without preservatives were almost totally destroyed; the ones treated with naphthalene were partially destroyed, especially the flowers and inflorescences, and the ones treated with paradichlorobenzene were not attacked.

The use of this substance, as compared with naphthalene, shows the necessity of replacing same more frequently on account of its easier volatility.

R. CIFERRI

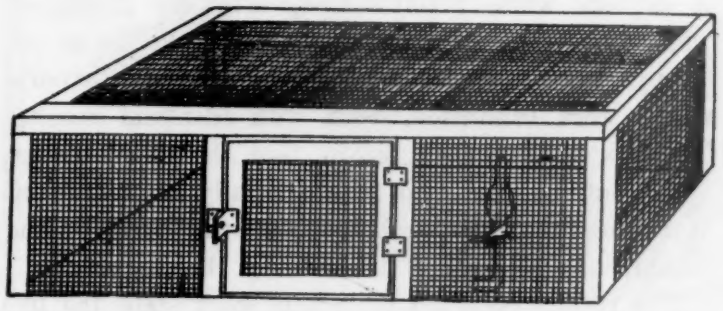
AGRICULTURAL EXPERIMENT STATION MOCA,
DOMINICAN REPUBLIC

SCIENTIFIC APPARATUS AND LABORATORY METHODS

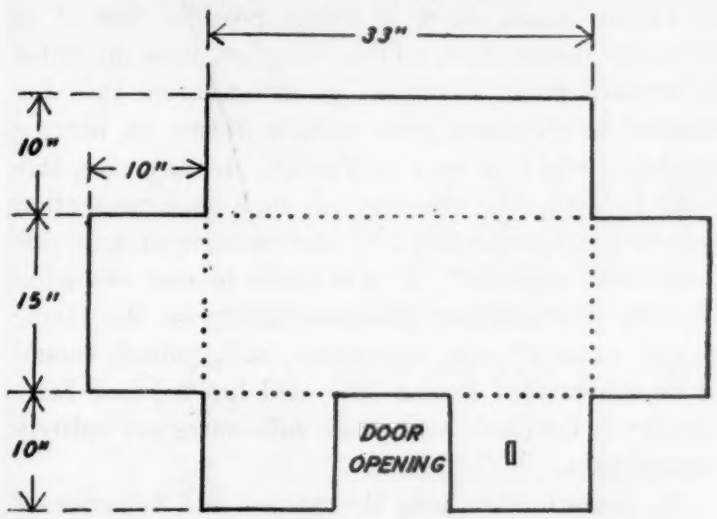
A SMALL ANIMAL CAGE WITH SANITARY FEATURES

BEING confronted with the problem of keeping a large stock of white rats in one corner of a general workroom in this laboratory, it was imperative that special attention be devoted to the sanitary features of the colony houses. Several standard types of houses were tried but none was found which would permit of easy cleaning so that odors could be avoided. The house which we have developed to meet this need should be of interest to other laboratories for three reasons: low cost, sanitary features and ease of construction.

The outstanding sanitary feature of the house is absence of seams at the bottom, so that the collection of soils in difficult-to-clean seams is avoided. All the



COLGATE SMALL ANIMAL HOUSE ASSEMBLED



PATTERN FOR CUTTING HARDWARE CLOTH
FOLD ON DOTTED LINES

walls of the house are constructed of hardware cloth with quarter-inch mesh which permits droppings to fall through the floor of the house where they are collected on drip sheets made from wrapping paper. The drip sheets are removed and destroyed three times a week.

The bottom and four sides of the cages are cut from a single piece of hardware cloth as indicated on the drawing. The top is cut independently and riveted to the frame last to facilitate ease of construction. The frame is made from strips of heavyweight galvanized iron an inch and a half wide which have been bent at right angles lengthwise through the midline. The corner bends of the frame are riveted and the hardware cloth is riveted to the frames, washers being used between the head of the rivet and the hardware cloth. Two hours' work will complete a house.

The houses are used in tiers, each house being supported by five-inch hooks which project from uprights at each end of the house. There are four hooks per cage. The sets of hooks are spaced vertically so that there is two inches clearance between houses, permitting the top of a house to be used to support the drip sheet for the colony above it. Solid boards for these vertical supports serve also to lessen drafts on the animals.

Every fortnight the houses are washed in hot oakite solution and rinsed. Coarse cedar shavings which can be secured at any pet shop are used for nests. Glass drinking tubes from the Emil Greiner Company are used. The food dishes used are of non-spillable type.

Six full-grown white rats are given ample exercising room in these cages, and for breeding special cages have been built after this same general plan but with two doors and a hardware cloth partition separating it into two compartments.

We have used this type of cage for more than a year with almost a complete absence of odor and with the time required for maintaining them in a fresh condition reduced to about ten minutes per cage per fortnight. Since they are galvanized throughout destructive rusting is avoided. The materials for a single cage cost about one dollar.

DONALD A. LAIRD

COLGATE UNIVERSITY

SPECIAL ARTICLES

SOLUBILITY OF URIC ACID IN THE BLOOD

DURING the course of a prolonged investigation on the excretion of uric acid by the fowl, attention was attracted to the question of its solubility both in the blood and urine. Not infrequently urine of a fowl taken directly from the ureter is in the form of a clear or opaque mucoid-like material in which are usually found white lumps of uric acid. The mucoid-like material has given rise to the idea that the fowl's urine contains mucus, but histological examination of the kidney and ureter shows no evidence of any such mucous glands. Furthermore, if one allows a

clear specimen of this material to stand, it gradually becomes opaque and deposits uric acid, thus behaving like fowl's urine in general. Microscopic examination of these deposits shows that they consist either of amorphous particles or of crystals. Crystalline deposits usually have a somewhat grayish appearance in bulk, whereas amorphous are often creamy white in appearance. If one warms fowl's urine containing deposits not infrequently they dissolve completely. This only occurs, however, if they be amorphous in character and recently formed. Crystalline deposits do not dissolve on warming. It became clear that the uric acid excreted by the kidney was in a different form from the insoluble kind which deposits on standing. Light was thrown on this subject by a few experiments into the formation of uric acid gels.[1] These are quite readily formed and behave in a similar manner to fowl's urine; that is to say, they contain a high percentage of uric acid which, in spite of the fact that when cold may actually gel, will filter quantitatively through a celloidin membrane and thus are clearly not colloidal. It is true that fowl's urine has not been observed actually to gel, but the mucoid-like material which may appear can probably be regarded as a close attempt.* Such a gel-forming solution if kept warm (*i.e.*, fluid), or diluted, and allowed to stand, deposits uric acid which may be amorphous or crystalline, and like the fowl's urine this may either redissolve on warming, or not, according to the character of the deposit.

Naturally these results led to the question of the state of uric acid in the blood. It is certainly being secreted by the kidney in some special soluble form as the remarkably high percentage achieved in the fowl's urine most clearly demonstrates. In order to study this question it was attempted to produce uric acid in a soluble form from one of the gel-forming solutions. This turned out to be an easy procedure since, if one merely takes a quantity of a known gel-forming solution and adds ten times its volume of pure acetone, the uric acid complex immediately appears as a white flocculent precipitate. This may be collected and dried *in vacuo*, the resulting material being readily soluble in distilled water. It should be noted that an alkaline solution of uric acid dissolved in soda does not behave in the same way; furthermore, these gel-solutions may be prepared with a fairly wide range of reaction, varying from strongly acid to litmus to mildly alkaline. Attention was then directed to the blood. As has been shown elsewhere following the simple procedure of tying the fowl's ureters, very high quantities of uric acid appear in the blood.[2] It will be noted that the figure mentioned in this paper, 120 mgs per cent., is higher than the solubility of uric acid in serum, taking the lowest figure that has been so far discovered (1 in 1,000).[3] Actually, in the course of this experiment the higher figure of 170 mgs per cent. was achieved, which was due to the fact that the bird was allowed to live for a long period before being bled. The blood obtained from the bird and rendered incoagulable by either heparin or oxalate was centrifuged, the clear plasma was then placed in a celloidin sac and filtered under air pressure. The resulting filtrate was a clear, colorless, protein-free solution. Some of this, which was allowed to stand over night, deposited crystals of uric acid which were insoluble on warming; to the remainder was added ten volumes of pure acetone. A copious white precipitate immediately developed which was centrifuged off. This proved to be an impure but soluble uric acid complex. Two experiments were conducted, both with identical results. There is no doubt, therefore, that the blood of the fowl contains uric acid in a specially soluble form. It is possible, even probable, that the blood of the human may also carry uric acid in this form.

The results obtained from this work show the importance of determining in what form uric acid exists in human blood, since it seems possible that if it normally occurs as a soluble complex, then, in order to explain gouty deposits, an investigation into the factors which cause such soluble forms to become insoluble might be very profitable. In any case, this work indicates the necessity for such an investigation before the introduction into therapeutics of any new "uric acid solvents." It also tends to cast suspicion already rife amongst pharmacologists on the therapeutic value of such substances, and, indeed, should it be shown that human uric acid has a blood form similar to fowl uric acid, these substances are entirely superfluous.

An investigation into the nature and behavior of this form of uric acid occurring in fowl's blood is to be made by my biochemical colleague, Professor E. Gordon Young.

CONCLUSIONS

Direct evidence is given which shows that the uric acid occurring in fowl's blood is in a specially soluble form.

OWEN S. GIBBS

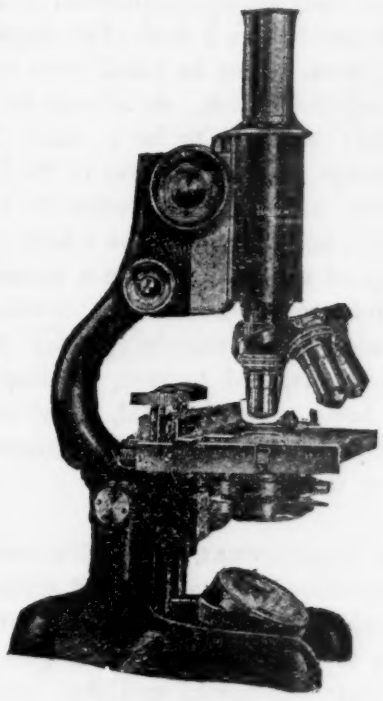
DALHOUSIE UNIVERSITY

[1] H. Schade and E. Boden, *Zeit. für Physiol. Chem.*, 1913, 33: 347.

* Since this was written Professor Young has manufactured a uric acid solution which has a very similar mucoid-like appearance.

[2] O. S. Gibbs, *Journ. Pharmacol. and Expt. Therap.*, 1929, 35: 49.

[3] Alonzo-Englebert Taylor, *Journ. Biol. Chem.*, 1905–06, 1: 177.



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PAPERS READ BEFORE THE INTERNATIONAL PSYCHOLOGICAL CONGRESS

PROFESSOR IVAN P. PAVLOV, of Leningrad, described the close and strategic connection between the hemispheres of the brain which form the switchboard for the most complex conditioned, or learned, reflexes, and the sub-cortical part of the brain lying immediately beneath the hemispheres, which is the center for the most complex unlearned reflexes such as those dealing with food, sex and self-defense. Dr. Pavlov said:

"On the basis of the most recent experiments, I find it justifiable to separate the reflexes of these two centers from the rest of the nervous activity under the special name of the highest nervous activity." The study of the mutual relation of these two highest parts of the brain must become one of the most important problems of the highest nervous activity. The cortical conditioned reflexes are formed by means of the sub-cortical centers. A certain degree of excitability of these centers is the essential condition for the formation of the connection between cortical cells and sub-cortical centers. For instance, if an animal is already fed before an experiment, it is difficult or even impossible to form the conditioned reflexes on food. Professor Pavlov's experiments lead him to the conclusion that the strength and real significance of the activity of the brain hemispheres rests upon the activity of the centers just below the hemispheres. And, on the other hand, the hemispheres serve as regulators of the centers below. The cells of the brain hemispheres are continually protected against overstimulation. If a stimulus from without exceeds the maximum limit, inhibition sets in to prevent the brain cells from so intense a stimulation. The same sort of inhibition acts as a guard if the sub-cortical centers become over-excited and attempt to send in too intense messages of hunger, for instance, to the highest brain centers. Referring to the inhibition resulting from too intense excitation in the sub-cortical center, Professor Pavlov explained that "this fact is obviously a vital one, as it distorts the actual normal relations and furthermore gives a satisfactory explanation of hysteria."

PROFESSOR H. PIERON, of the Collège de France, stated that there is no pain sensation, though, when you cut your finger, you may be under the impression that you are experiencing a sensation of pain. Pain is really an emotional level which may be reached when certain specific sense organs are stimulated. The list of the five familiar senses, sight, hearing, smell, taste and touch, has long ago been expanded by psychologists to include the muscular sense, temperature sense, and sometimes several others, but if Professor Pieron's interpretation is accepted, pain would not be included.

PROFESSOR GOODWIN WATSON, of Teachers College, Columbia University, New York City, asked four hundred students to tell whether they considered themselves happy or miserable, rating themselves on a scale of six degrees of happiness and unhappiness. Then he asked them to give a number of facts about themselves. As a result he found that the happy student is likely to be a man. He is likely to be above average in health; active in the life of the college; to believe himself able creditably to tell jokes, lead a discussion, act in a play, give a talk on sex, or administer a group of workers; to have a harmonious home; to enjoy his job; to like adventure. Intelligence appears to have nothing to do with happiness. Nor is much importance to be attached to race, physical disability, size of one's home town, financial, social or educational status of family, nor to personal estimates of ability at sports or at the various arts.

PROFESSOR STEFAN BLACHOWSKI, of the University of Poznan in Poland, questioned several hundred students at the university and has found that 54 per cent. of them have the inclination to count objects, to a greater or lesser degree. Professor Blachowski said that heretofore attention has been attracted chiefly to the extreme and abnormal cases, such as individuals who feel themselves compelled to count the steps they take or the words they hear, and who become enslaved to a habit that they feel helpless to shake off. Among the university students, counting was more prevalent among women than among men. About two thirds of the women had the inclination, as compared with less than half of the men. The objects the different students counted make a long list. Among the most popular were planks in the floor, wallpaper patterns, windows, pictures, buttons, stops during a walk, trees, autos, books on shelves, equipages at funerals, stakes in fences, houses from one end of the street to the other, letters, money and railway cars. The statement made by one student applies to most of the cases—"If I see something arranged in a row, pictures on the wall, for instance, I count them." Another student said that when he took a railway journey he always counted the stations and the houses and jotted down his precise observations in a diary. Since so many normal people occupy their minds with this form of thinking, Professor Blachowski believes that the matter should be studied more deeply than when it was merely supposed to be a phase of mental disease.

DR. GEORGE H. GREEN, of University College of Wales, speaking before the International Congress of Psychology, said that he found indisputable evidence that Welsh children do display racial prejudices. Books are of greater importance in forming the opinions of children regarding alien races than either school or religious instruction, he found. The rôles played by the Negro and Chinese in moving picture dramas have strongly influenced childish opinion regarding these races. But the movies do not seem to have affected the attitude of Welsh

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children toward Americans. Facts collected regarding the influence of books, movies, newspapers, religious institutions and other agencies that shape children's opinions toward the races of the world can be used to make these agencies more effective in a constructive way, the educator pointed out.

THE child who persists in pushing his pen backhand style in spite of school fashions in penmanship is really seeking to attain a harmony of movement, in accordance with his own physical traits. Even though he may not be recognized as a left-handed individual, his desire to slant his writing backward is an indication of some left-handed or left-eyed trait, according to Dr. June Downey, of the University of Wyoming. Forty-five supposedly right-handed individuals who slant their writing back were studied. Some of these were left-handed children who had been taught to use the right hand. Some were ambidextral. Fully sixty per cent. of the group either had the left eye dominant, or else the two eyes were impartially depended upon. The backward slant of writing favored by left-handed persons and the forward slant more customary among right-handed persons suggest a centrifugal preference of movement.

CHILDREN take, on the average, twenty minutes to go to sleep. This is the finding of the mothers of one thousand children under eight years of age who have kept records in cooperation with Dr. Josephine C. Foster, of the Institute of Child Welfare at the University of Minnesota. Describing the sleeping hours of children, Dr. Foster stated that children less than six months old sleep about fifteen hours a day. Children seven years old sleep practically eleven hours. Averaging the records of children of all ages and records of all seasons of the year, the time required for dropping off to sleep was twenty minutes. Late hours, popularly associated with city life, do not affect city children. Country children went to bed later and rose earlier. This difference is particularly striking in the spring.

FEAR of the unknown plays a major rôle in the drama of every human life, according to Dr. L. Seif, of Munich. When a child begins to ask "why" at four years of age he is already trying to overcome the feeling of uncertainty and anxiety that human beings naturally hold toward what is strange. Strange experiences and objects are new, uncertain, dangerous, and such things are faced throughout life with anxiety. What is known, on the other hand, is safe and inspires confidence. If a child receives from his educators the right preparation—love, confidence, encouragement and suitable training for overcoming the difficulties of the strange—he then learns always better to transform the strange into the known. If a child is spoiled, he does not learn to deal courageously with the strange. His experiences are characterized by disappointment, anxiety and withdrawal. A pessimistic response to strangeness in life constitutes the basis of many mental and nervous disorders.

THE personal relation of the actor toward his rôles has been studied by Professor John T. Metcalf, of the University of Vermont. Professor Metcalf said that the actor enjoys his work when he is satisfied with his art, and his work is unpleasant when he feels his own shortcomings. The actress who weeps through a tragic love scene and has her audience weeping with her is probably thoroughly enjoying the evening's work. The actor who is so despicable a character that the audience yearns to come up on the stage and take a hand in his downfall probably has no feeling of repugnance toward his part in the drama. To what extent an actor feels the emotions he portrays has long been a matter of interest and dispute. Professor Metcalf concludes that the actor does imaginatively identify himself with some person and situation outside of himself. And the more fully he is capable of this, the more successful he will be in conveying the desired effect to the audience. But if he begins to experience the real sensations of anger or sorrow, he slips up in his art, for then he is behaving in a real and practical way instead of using his art to represent an imagined situation in the realm of unreality.

INTERNATIONAL COOPERATION IN THE STUDY OF PACIFIC PROBLEMS

SCIENTIFIC cooperation between all the nations whose lands border on the Pacific Ocean, toward the conquest of research and practical problems involving all of the sciences, was urged before the meeting of the Pacific Science Council in Java, from which Dr. T. Wayland Vaughan, director of the Scripps Institution of Oceanography, has recently returned. A number of resolutions putting various steps of the contemplated program into definite form were laid before the council and unanimously adopted.

One of the most ambitious of the projects is the surrounding of the Pacific with a chain of oceanographic institutions like the one at La Jolla, which will serve as headquarters for the laboratory attack on ocean problems and as bases for the operation of scientific expeditions in the field. The council recognized that the vastness of the Pacific precludes the possibility of any one institution, or any one country, taking over the whole of the work, and agreed upon the great desirability of international effort among all the governments concerned, with a coordinated program of work for all existing institutions as well as the new ones that may be established.

The recklessness with which hunters and collectors, both commercial and scientific, are depleting stocks of wild animals and plants, even in the prolific tropics, was specifically condemned in two resolutions, and conservational measures were suggested. Other resolutions proposed new lines of research, or commended those already in progress. Among these are the study of variations in terrestrial magnetism, of earthquakes in the region of the China Sea, of geological survey work in the same region, of investigations of the structure of certain typical coral islands, and of the mapping of oceanic depths by means of echo-sounding.

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THE TEMPERATURE IN NORTHEASTERN SIBERIA

WHILE the western world is sweltering in heat waves, up in the northeastern corner of Siberia, Professor S. W. Obrutchev, of the Russian Academy of Sciences, and a party of fellow scientists are seeking colder places than any that have previously been reported to science.

Two years ago Professor Obrutchev, on another exploring expedition in the district known as Oimekon in northeast Siberia, found a region where comparative temperatures were lower than those at Verchojansk, up to the present time the acknowledged pole of cold. Verchojansk is roughly 500 miles distant in a northwesterly direction from the new cold spot and well within the Arctic circle. The new cold area lies slightly below the circle in the temperate zone.

When the explorers set out the first time they did not anticipate such extreme cold and had not included alcohol thermometers in their equipment. Consequently they could not take observations below minus 39.4 degrees Centigrade, or 48.9 degrees Fahrenheit below zero, the point at which the mercury thermometers froze. They stayed frozen, however, for twelve days, during a period in the month of November when, it was ascertained, such temperatures only lasted for two or three days at a time at Verchojansk. In October they found that daily temperatures averaged about nine degrees Fahrenheit below that of Verchojansk. The lowest cold temperature officially recorded for the latter place is 90 degrees below zero Fahrenheit.

If confirmatory data on these temperature relations are gathered on the present expedition, it will be apparent that the area of the world's coldest regions extends much farther to the southwest than was previously believed, a fact of considerable importance in making meteorological studies. Isotherms which were previously disposed in rings around Verchojansk must be transferred to include the region around the Okhotsk Sea.

ITEMS

SINCE November, 1928, eleven outbreaks of botulism have occurred in the United States that have been traced to home-canned food. In all, 35 cases occurred, of which 21 died. The frightful mortality of this disease makes extra precautions in canning vegetables and meat extremely advisable. The spores of the organism causing botulism can be killed only by long-continued heating, a condition that automatically condemns the cold-pack method in favor a few years ago. Ten per cent. brine should be used for non-acid vegetables and meats, or else these foods should be boiled for some time after they have been removed from the glass jar in which they have been preserved, according to medical authorities.

INSULIN, which saves the lives of diabetic patients by ridding their blood of an overload of food in the form of sugar, is proposed by German prison physicians as a means of breaking the "hunger strikes" of prisoners, according to an editorial note in *Kosmos*. Injected into the blood-stream of a healthy person, insulin acts in much the same manner as it does in a diabetic; that is, it reduces the amount of sugar. But if the amount of sugar is not excessive, it is reduced to the point of physiological starvation, and the "hunger striker" gets so sudden and violent an attack of the hunger he is striking for that he is unable to hold out, and asks for food.

THE Wisconsin Alumni Research Foundation has filed suit against the Solar Research Corporation and the Sargent Drug Company, charging infringement of patent rights which the foundation holds on the process of irradiating foods and medicines. The patent rights cover the process developed by Professor Harry Steenbock, of the University of Wisconsin, by which foods and medicines may be supplied with vitamin D, or their vitamin D content increased, as a result of exposure to ultra-violet rays. This vitamin is the growth-promoting anti-rachitic factor contained in large amounts in cod-liver oil and in lesser amounts in certain foods. When Professor Steenbock found a way of making ordinary foods rich in this important vitamin, the Wisconsin Alumni Research Foundation applied for patent rights on the process, so that its benefits might be made available to the public under properly controlled conditions. Licenses to use the patented process have been granted to some commercial companies. The manufacture of irradiated foods and drugs by these companies is under the supervision of the foundation and Professor Steenbock. The proceeds from the licenses of the patent rights are used for further scientific research at the University of Wisconsin.

TENAYUCA, the Aztec ruin which has already yielded so many interesting objects of a past civilization that it is undoubtedly the most important Aztec site in Mexico, recently gave up three more idols of stone. Two are sitting on their haunches and have their hands on their knees while their heads bear ornate head-dresses. A third idol is just a face broken off a body that has not yet been found. All three represent priests or gods, who may be identified later when their adornments are studied. The style of carving is Aztec. The site of Tenayuca has yielded an enormous quantity of pottery, whole and in fragments, which has been classified and is being studied by Eduardo Noguera, of the Direction of Archeology of the Mexican Ministry of Education. Some stratigraphic explorations have been made to determine the succession of cultures that have existed in that region. Pottery fragments belonging to the Archaic, Toltec and Aztec periods have been found, and objects from the oldest of these periods, the so-called Archaic, have been found to an unusual depth, indicating that Tenayuca has been occupied continuously for very long periods of time. A combined study of the architecture of the pyramid, the story the pottery fragments tell, and the numerous hieroglyphs carved on the pyramid stairway and at other places is now being made by Mexican government archeologists.

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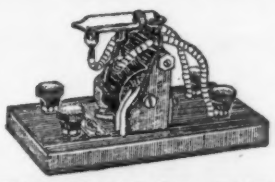

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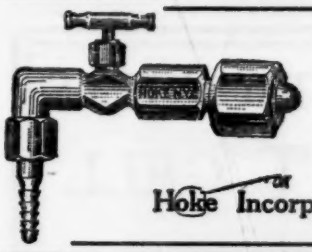

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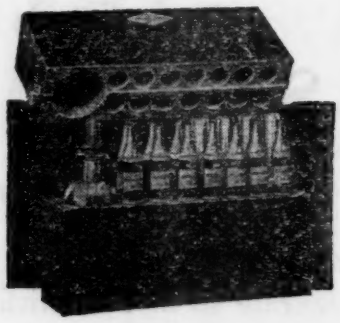

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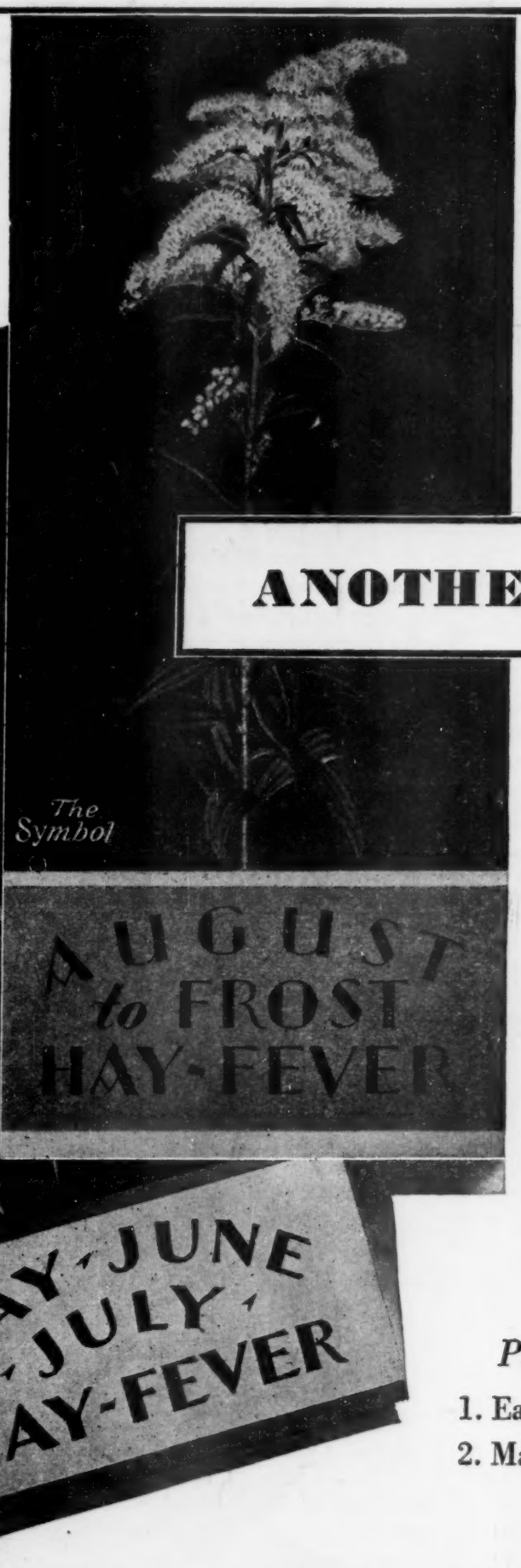

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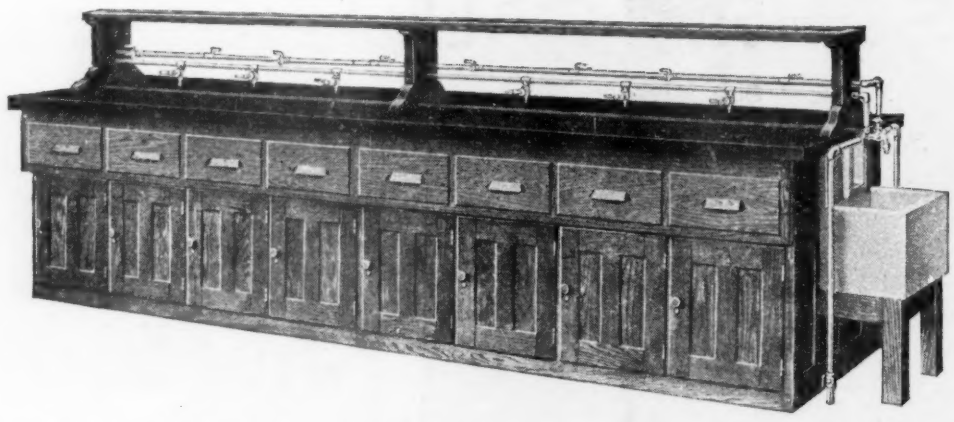

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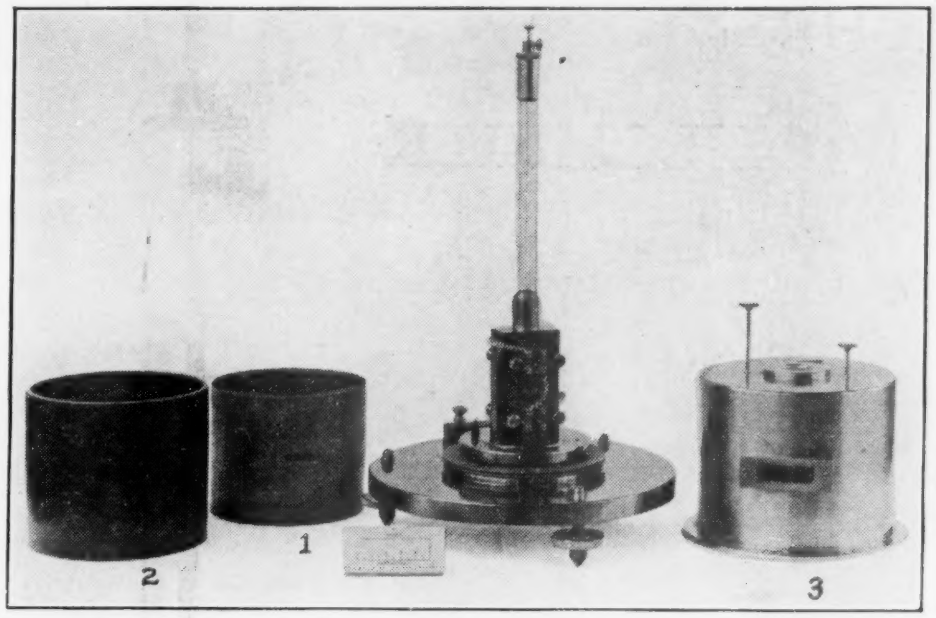

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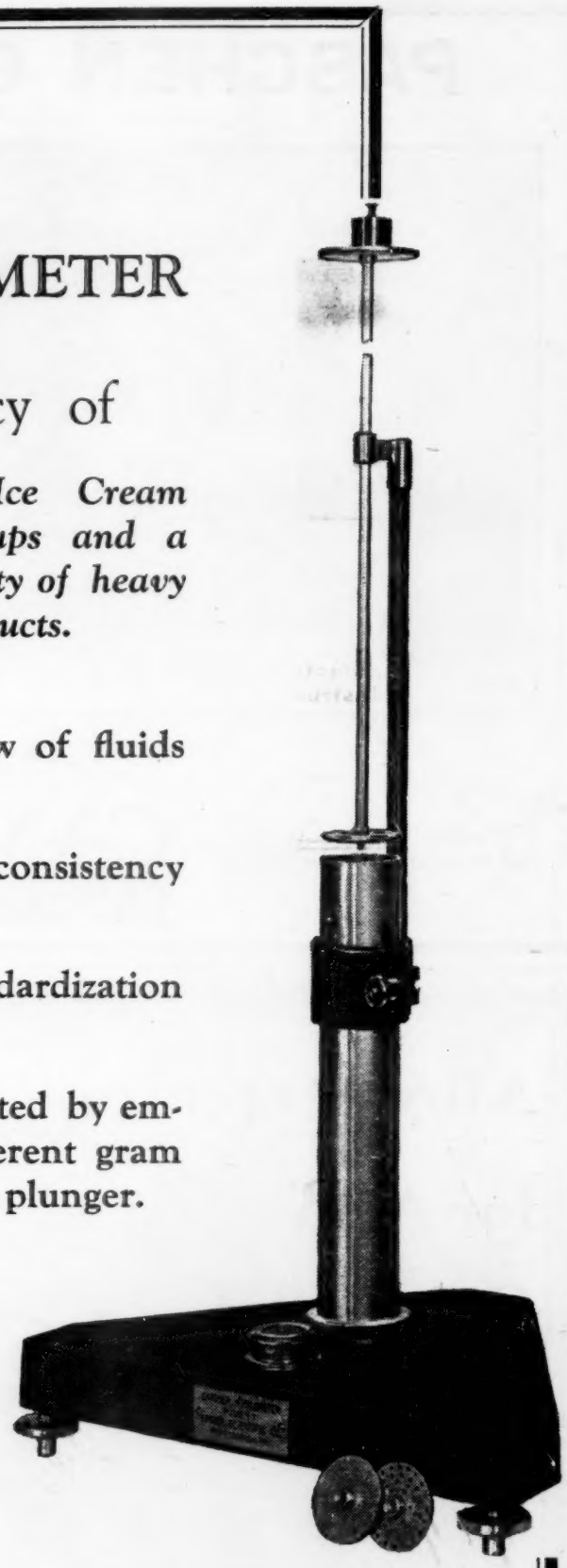

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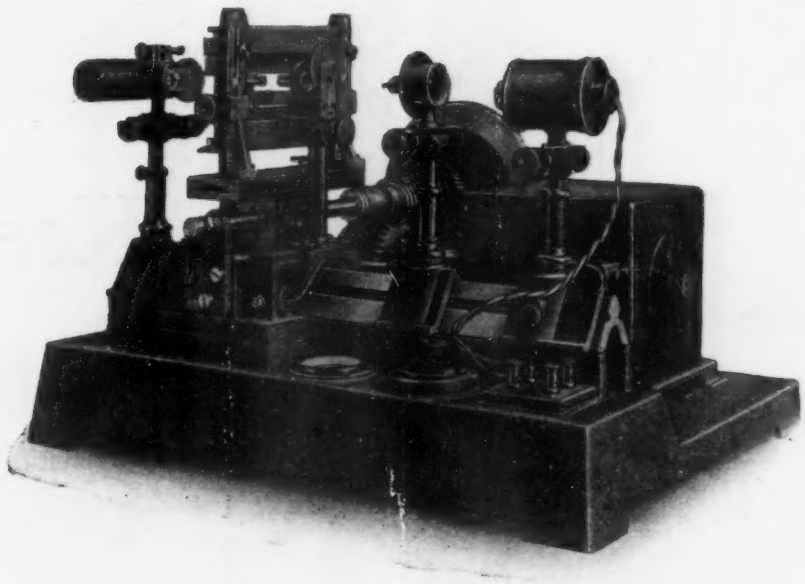

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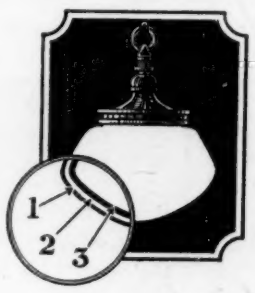

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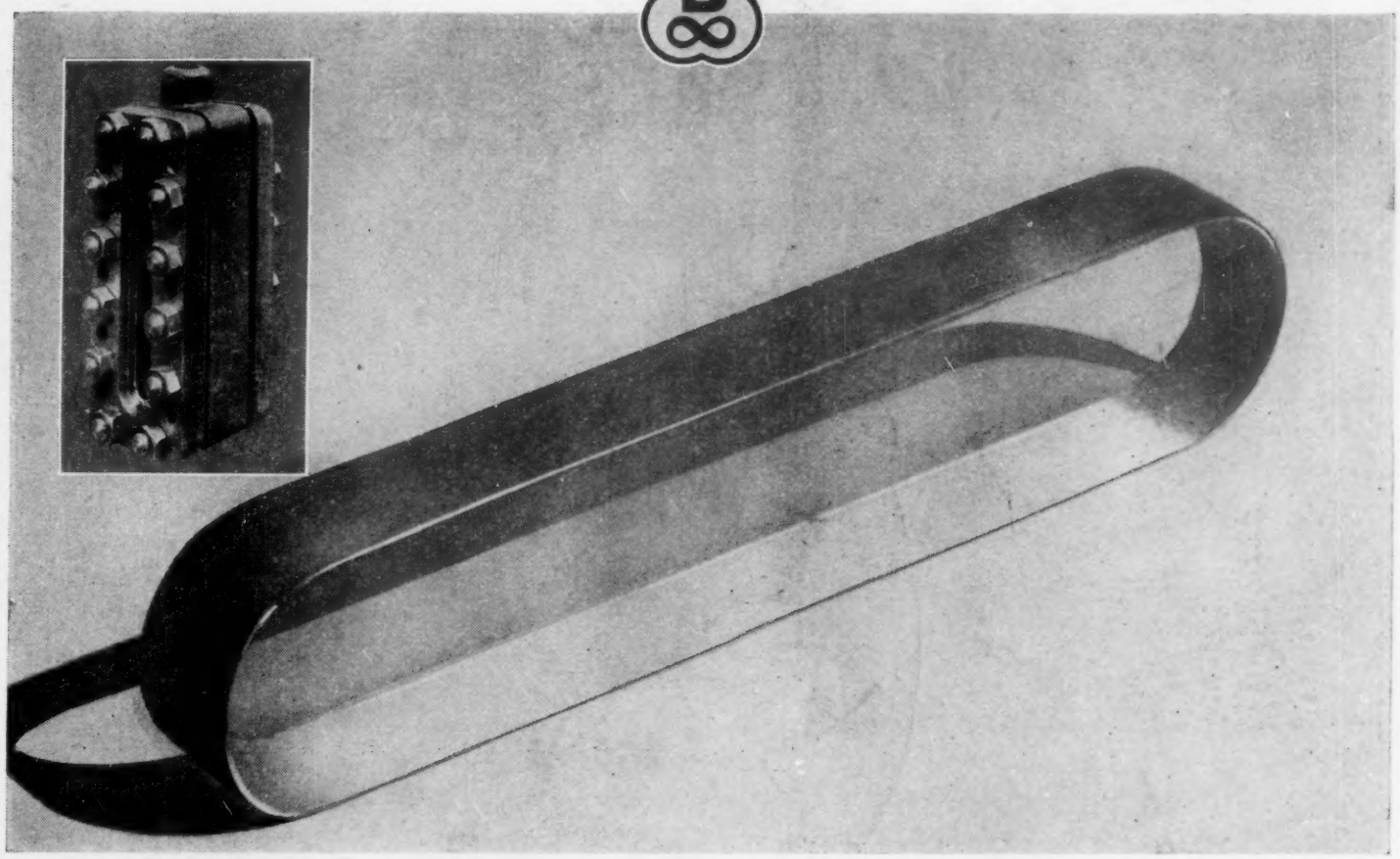

Goulds high pressure oil gauge, and panel of Amber Bakelite Resinoid used to cover indicator. Goulds Pumps, Inc., Seneca Falls, N.Y.

Amber Bakelite Resinoid proves superior *for high pressure oil gauge*

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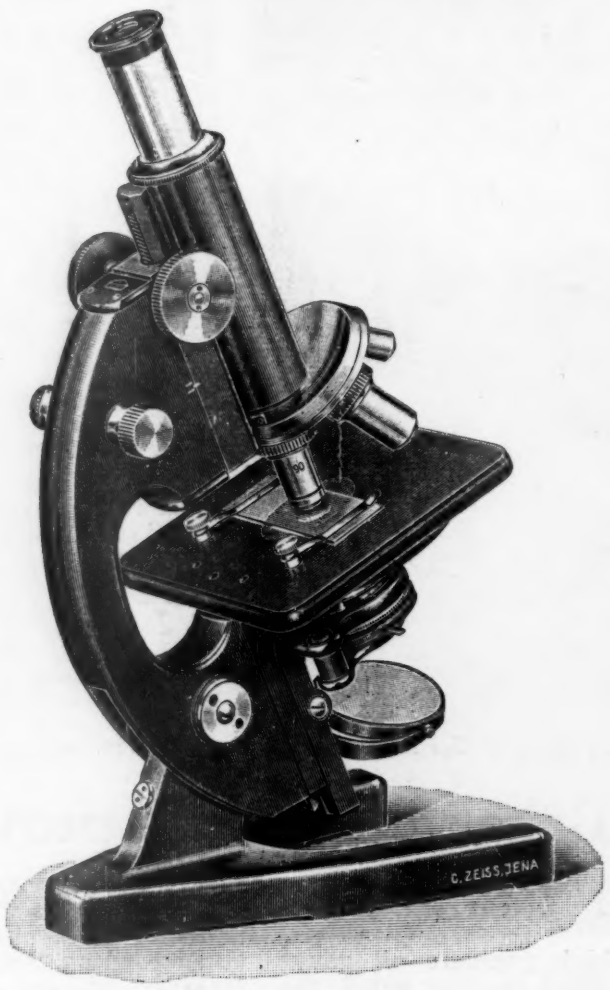

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